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ANNALS OF BEE CULTURE

FOR 1872;

A BEE-KEEPER'S YEAR-BOOK,

D. L. Adair, Editor, . . Hawesville, Ky.

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THE ANNALS OF BEE CULTURE.

THE GENESIS OF THE HONEY-BEE.

BY D. L. ADAIR.

The Animal Kingdom is divided by naturalists into two grand divisions; viz., *Vertebrates*, or such as have a back-bone or spine, of which man is the most perfect type; and *Articulates* a term, which Cuvier selected as descriptive of their peculiar formation of segments, joints, or rings, as all of them can be reduced to a simple, typical figure, that of a cylinder divided into numerous segments. Entomologists divide the latter into three classes, viz.: 1. *Worms*, or such as consist of a long cylindrical sac, composed of an indefinite number of rings, all nearly alike, without any appearance of subdivisions into regions; 2. *Crustaceans*, or such as are composed of a determinate number of rings, which are grouped together in two regions, the head and abdomen, or anterior and posterior, of which the crab, lobster, and shrimp are examples. The third and highest class consists of *Insects*, or such as have their bodies subdivided into three distinct regions—the head, thorax, and abdomen; each region provided with a distinct set of organs, having distinct functions. The insect is placed at the head of articulate animals.

Insects are divided (Packard) into three orders; the lowest the Myriapods, or such as have cylindrical worm-like bodies, with segments not distinctly grouped into regions, except in the recently hatched young; the centipedes are an example. The next or intermediate order, the Arachnidæ, which includes the spiders, having only two distinct regions, are wingless, and have four pairs of legs. The third or highest order, the Hexapods, or six-footed insects, generally have two pairs of wings, and the segments grouped into three distinct regions.

The hexapods are divided by Agassiz and Packard into seven suborders, at the head of which they place Hymenoptera, which culminates in *Apis*, the honey-bee.

Dr. Packard (*Guide to the Study of Insects*) says: "In the unusual differentiation of the individual into males and females, and generally sterile workers, with a further dimorphism of these three sexual forms, such as Huber has noticed in the humble-bee, and a consequent subdivision of labor among them; in dwelling in large colonies, thus involving new and intricate relations with other insects; their wonderful instincts; their living principally on the sweets and pollen of flowers, and not being essentially carnivorous (*i. e.*, seizing their prey like the tiger-beetle) in their habits; and in their relation to man as a domestic animal subservient to his wants; the bees, and hymenoptera in general, possess a combination of characters which are not found existing in any other suborder of insects, and which rank them first and highest in the insect series."

All insects have their origin in the ovaries of the mother, in the egg or its equivalent, and pass through certain transformations or metamorphoses; and as they have an important bearing on many of the operations necessary to successful bee culture, and those peculiar to the honey-bee are but imperfectly understood even by naturalists, we propose to give, in short, a sketch of those transformations as they take place in the worker-bee; and if we differ in some respects from naturalists of recognized eminence, we do so because our own observations as a practical apiculturist for seventeen years we consider justifies it, and because we consider that a proper understanding of the subject will correct many erroneous practices in bee culture.

The egg of the honey-bee consists of, first, a shell, or, as naturalists call it, *chorion;* second, of a thin membrane or lining called the vitteline membrane or yelk envelope. These inclose, third, albumen; fourth, an oil which forms the yelk; and fifth, the germ or embryo, which is the animal, whether male germs are added to it or not. It is a vitalized bud, as much so as its analogue in the plant or tree, the product of animal reproduction, fertilization only changing the sex. The egg is deposited by the queen in the cells of the comb.

When the vital principle is excited to action by the proper degree of heat the embryo absorbs its stored food, which develops organs and appendages to prepare it for its second stage, and at

the end of about three days, under favorable conditions, if a proper temperature is maintained in the hive, it bursts open the shell and emerges in the form of a minute worm, and is then called a *larva*.

In this second stage it has no resemblance to the perfect bee. It has a mouth; its only organs being the organs of nutrition, which are very simple, being nothing but a straight tube ending in a blind sac, or bag, having no outlet; as it lives on liquid food perfectly adapted to all its wants, all of which is digested and appropriated, and no residuum left to be excreted, as is the case with the *larvæ* of many insects.

From the time it leaves the egg it feeds voraciously on the whitish fluid which is deposited in the cell by the nursing bees so plentifully that it floats in at first, from which fact it is but reasonable to suppose that it absorbs its nourishment as well as feeds upon it. From a worm without any rings it soon grows into an articulated animal, and fills the cell in four to six days, when it is sealed up by the nursing bees with a cover placed over the mouth of the cell. In the course of thirty-six hours the larva spins around itself a silken cocoon, which lines the cell, and enters its third stage, which is called its *pupa* state.

This second metamorphosis finds it entirely changed in form, and from a worm composed of simple rings it is transformed into an insect with its three divisions of head, thorax, and abdomen. Its internal organs undergo as great a change; but, as during this stage no food is taken nor excrement discharged, its stomach has no outlet posteriorly, only the rudiments of the anal outlet being formed.

Dr. Packard, quoting from Weismann, says: "Accompanying this change in the integuments there is a destruction of all the larval system of organs; this is either total or effected by the gradual destruction of tissues."

After the worker-bee pupa has reached its twenty-first day, counting from the laying of the egg, it has perfected its form and enters on its fourth or imago stage, when it cuts away the cap of the cell that imprisons it and issues forth to mingle with the crowd in the hive. It is then considered by entomologists as a perfect insect, but it is evidently not so.

Dzierzon stated, as the result of his observation, that the worker-bees attended to the domestic concerns of the colony during the early period of their lives. The introduction of the

Italian bee enabled Dr. Donhoff to make such observations as confirmed the correctness of this opinion. His experiments, as detailed by himself, are given in "Langstroth on the Hive and Honey-bee," page 194, but are too long to be quoted here. My own observations confirm Dr. Donhoff's, and I think establish the following as facts:

1. The honey-bee is not a perfect insect when it attains its imago or so-called perfect state.

2. The worker-bee passes through a fourth stage before its organs are perfected, which I call its *adolescent* state, which ordinarily extends over a period equal to the whole time required for all the other transformations, and extraordinarily, or during a period of rest or hibernation, over an indefinite period.

3. During the first three days of adolescence it does not eat at all, its alimentary organs not being perfected. For from three days to a week after that it only eats bee-bread; it then begins to eat honey sparingly. Up to this time it evacuates no excrement. and it is but reasonable to suppose that the anal tube is imperfect. It continues to feed on the same kind of food that nourished it in its larval state, while the adult bee is never known to eat it.

4. The adolescent and the adult bee perform entirely different offices in the labors of the hive. From the food used by the former is secreted the wax with which they build their comb-structure. It is doubtful whether the adult bee is capable of producing wax at all. The young bee also builds the cells and feeds and nurses the brood. Huber noticed that a certain class of bees, which he called *nourrices* or *petites abeilles*, fed the larvæ, and supposed that the wax-makers were a different class, which he called *cirieres*. He distinguished them by their size, not suspecting that the latter were distended with the food they eat to produce the wax secretions. He also confounded the adult bee with the former or *petites abeilles*, they being about the same size, and attributed to them the additional office of honey-gathering.

5. The adolescent bee not only constructs the ordinary worker, drone, and store-cells, but when necessary constructs the cells for rearing queens, and attends to feeding and nursing them through the larval state. The adult bees are incapable of queen rearing.

6. The adult or perfect bee only gathers stores and propolis. So far as I have been able to see, it does nothing else.

These being facts, I conceive that they can only be accounted for upon the hypothesis that an additional transformation of the

internal organs takes place in the adolescent bee during its semi-adult state, and incidentally from the food taken the wax is secreted; or after the stomach has partially digested the food, and abstracted such elements as are necessary to its full development, the residue, instead of being evacuated as *fæces*, is fed to the *larvæ*, it being exactly suited to their necessities. As soon as the alimentary organs are perfected it enters its fifth stage and becomes an adult, and as such can no longer perform such offices, being physically incapacitated.

The period of adolescence extends over an indefinite length of time, the young bee being required to work over a certain quantity of food in order to extract from it the necessary amount of the peculiar elements necessary to its full development; consequently during the honey-gathering season, when much brood is being fed and much wax produced, its extreme limit does not exceed forty days, while the bee emerging from the cell in the fall continues in that state until the next spring.

The experienced bee-keeper will readily see what an important bearing this theory has upon the success of many operations necessary in scientific bee culture, as it will explain the cause of many failures and mishaps that were before mysterious.

It will point out the true theory of artificial swarming. A swarm made up entirely of old bees are unable to produce a queen, and consequently would fail; or in case a queen be given them, they would be unable to feed and nurse her brood, and unless comb was given them there would be no place for the queen to lay eggs. If composed entirely of young bees, they would be in a better condition, provided they were supplied for a while with food, as they could construct comb, rear a queen, and nurse the brood, and when they reached the adult state, if other young bees were produced to take their places, they might prosper, but their prosperity depending on so many contingencies, they would not so soon become strong as if the proper proportion of each class of bees with brood in all stages and a queen were united at once. For if there be the proper proportion of each to begin with, we may venture to make the swarm much smaller than when any of the requisites are wanting.

Since the invention of the Melipult, and the discovery that much honey is used in generating wax, the greatest want of the bee-keeper has been more comb to receive the honey. Many plans have been suggested to obtain it, and inventive genius has

been called on to supply it artificially, without knowing that in every hive of bees where brood is being matured there is a continual involuntary production of wax going on, and in every hive that has no vacancies for building comb it is being wasted. dropped on the bottom and swept out by the bees, or accumulated in every crack or crevice it falls into, to become a food and harbor for the moth-worm. The wax is lost. Nor is that the worst of it, for adolescence is prolonged and valuable time is lost by detaining in idleness great numbers of infant bees, that were they relieved of the accumulating wax as fast as it was ripe would sooner reach the adult state and become honey-gatherers. It has another bad effect, as it is the ordinary cause of natural swarming. The nursing bees prepare more food than there are *larvæ* to feed it to in the ordinary quantities. Some of these are supplied largely, and from them queen-cells are started, which seems to produce disorganization, and instinct impels the bees to migrate to a new home, where they can find room to use the accumulated wax, in the cells of which the food in the stomachs of the nurses can be used to rear another generation. Any one who has noticed how rapidly comb is built by a natural swarm can not doubt that the bees carry the wax with them from the old hive.

It will be easily understood under these circumstances that it is important that there should always be room in the hive for the continual deposit of wax in comb-building, not in boxes of difficult access, but in close proximity to the normal cluster, where the queen can have access to it, to deposit eggs in it, which she will do more readily and rapidly in half-furnished cells, and by that means allow the nurses to relieve themselves of their loads of brood-pap. An extra extent of box-room will not remedy the difficulty; for while it may enable the wax-makers to rid themselves of some of the wax-scales, it gives no extra room for the queen and nurses.

The hive should therefore always contain one or more vacant frames, or frames in process of being filled. We may thus secure an incredible number of comb-sheets, and to a great extent obviate the necessity of artificial comb; the increased activity of the adolescent bees will sooner fit them for honey-gathering; the queen will be stimulated to lay a greater number of eggs, rapidly extending her brood-nest to the new comb, the result of which will be an increased strength of bees, and consequently greater stores of honey, as long as pasturage continues.

FERTILIZING QUEENS IN CONFINEMENT.

BY MRS. E. S. TUPPER, OF DES MOINES, IOWA.

At the Bee-keepers' Society at Cleveland a member expressed utter disbelief in the assertions of many that they had secured the fertilization of queens in confinement. He made what no doubt appeared to him a most liberal offer of five hundred dollars to any one who would go to his apiary and secure the fertilization of fifty young queens in confinement. Little notice of it was taken. It was received very much in the same spirit as would have been an offer of the same sum to any one who would show him fifty queens, asserting there were no queens, but the workers deposited their eggs!

No doubt there were many present who had never succeeded themselves in securing the fertilization of queens in confinement; but in this age of progress few are willing to say that a thing can not be done because they never did it or saw it done. It must be evident that no one could afford to leave his own apiary in the busiest season to try experiments for others, or teach them how to do what they have failed in doing. We do not think Gen. Adair, L. C. Waite, Dr. Mitchell, or any other of the successful ones in this matter will be likely to jump at this offer; but we do hope they will all be able to give in these annals and other periodicals such reports of success in this important matter, with methods of securing the end, so simplified that even the novice can control the mating of the queen without trouble.

In the summer of 1870 I failed in many of my first attempts, as I now know, because I did not secure in the cages I then used sufficient warmth. After the season advanced, and warm, dry weather came on, my failures were few. I succeeded with twenty-seven queens, more than nine tenths of the times I attempted it. During the past season I did not in a single instance fail when I tried. I used the cage of my own making at first, but afterward received a fertilizing cage from Gen. Adair, which was much more easily managed. Under proper conditions of warmth, and age of both drone and queen, the failures need be very few when this cage is used. I also succeeded with the wire dish-cover, as used so successfully by L. C. Waite. My long illness during the latter part of the season interrupted my experiments.

In October I found a number of young queens hatching in colonies, from which an assistant had removed the queens. I removed several of these to small hives, and to one of these attached one of Mrs. Farnam's non-swarming attachments. The young queen was fertilized in the box of this, and four times afterward I succeeded in having queens fertilized in this box. Though not recommended by the inventor for this purpose, I am sure they will be valuable for it, as neither drones nor queen have to be caught when this is used, but fly naturally from the hive. It will be easy for a novice to try it. It also possesses the advantage of being out in the sun and air.

In conclusion, let me say that there remains for me no doubt that it is only necessary to have the queen and drone of ripe age, and the cage favorably situated as to warmth, to insure success in every trial. Not only is the process very important where black bees are near our Italians, but it gives us great advantage in crossing different stocks, and in the selection of the best drones, instead of leaving the matter to chance.

THE EGYPTIAN BEE.

BY M. BALSAMO CRIVELLI, OF ITALY.

Translated from "*La Culture*," published in Paris, France, for the "Annals of Bee Culture," by C. P. DADANT, of Hamilton, Illinois.

Those who now practice bee culture in Egypt are the tribes of the Fellahs and of the Coptes. The Bedouins who inhabit the border of the desert do not occupy themselves with this branch of agriculture. Bees are kept in boxes or in pots; these pots are closed at the end as soon as the bees are hived in them. They also use cylinders made of mud taken out of the Nile. Those cylinders are fifteen inches in diameter by three feet in length, having the same capacity as a large Dzierzon hive; the sides are three inches thick, and the ends are closed with disks made out of the same material, one of them having a small opening for the entrance of the bees. These cylinders are generally piled up like drain pipes. The straw hive seems to be unknown in Egypt.

The bees find their principal nourishment on clover (*trifolium alexandrinum*). The largest part of the plants and trees bloom in the month of March. In the gardens bees gather honey and pollen from sunflower (*helianthus*), cucumber, melon, onion, bean, etc. In the country of Rei the crops are gathered in May, and after that time large tracts of land remain dry and gloomy. The country of Sharaki, being irrigated, gives three crops during the year. There the bees can gather honey during the greater part of the year. Acacia blooms as late as October.

In upper Egypt, swarming takes place in February and lasts until the middle of March.

To force the swarms to build straight and in a parallel with the disk which is used in place of a door, they fasten some old combs to a piece of wood and fasten this inside of the hive. The combs are then constructed in the upper part and near the guide. They can be easily extracted by cutting them loose at the top. We might almost say that the Arabs are acquainted with movable combs. All the combs that the bees build are parallel to the one introduced. By this process the management of the cylinder is greatly facilitated. The Fellahs are not so ignorant in bee culture as one might think at first.

In Egypt the principal enemies of the bees are wasps and hornets. The hornets attack the bees in front of their hives, when they return from the fields; they even enter the hives to get the honey. The wasps do not kill the bees but they rob them. At a certain time of the year a man has to stand in the apiary to watch the hives and drive away the hornets, for the latter would rob and take away all the honey. The bees can not control a hornet so as to be able to sting it, and when robbing is begun it is difficult to stop it. In Egypt, to operate on bees and gather honey, they do not use any means of defense, and they handle them with naked face and hands.

EXTERIOR APPEARANCE OF THE EGYPTIAN BEE.

The Egyptian colonies, like our common black bees, are composed of three kinds of bees: drones, queen or mother-bee, and workers.

The workers of the Egyptian race have the first two rings of the abdomen marked with a reddish yellow or orange color, and the third ring half yellow and half black, like Italian bees. But

while the Italian bee has the first two rings entirely yellow, the Egyptian bee has a black line on each of these rings. Besides, it differs from the Italian bee in the color of the thorax, which is entirely yellow; the ends of the jaws and the forehead are of a rusty red. The body is covered with a whitish coat of hairs. On each side of the head these hairs are of a dark brown, and white in the center.

The Egyptian bee, seen from behind, seems to shine, on account of these white hairs. When on the wing it seems to be covered with flour. A practiced eye can follow it easily and recognize it among Italian bees. The difference in size is very noticeable. The Egyptian bee is smaller and more active than the Italian or the black bee.

The Egyptian drones have the first two rings of the abdomen of a reddish yellow, and the third of a lighter color. They resemble the most beautiful Italian drones; but they differ from them in the brightness of their thorax, so that they look quite different from the former when on the wing. The Egyptian drones are smaller than the Italian and German drones. They are also less weighty.

The Egyptian queen differs widely from the Italian queen. The first abdominal rings of the former are of a reddish yellow color, and on a few of the nicest queens they seem to be spotted with blood. A bright black line extends on each of these rings, and becomes broader and broader toward the end of the abdomen. The thorax is of a brownish gray color, and is covered with hairs.

The wings of the Egyptian bees are smaller than those of the other races. The noise produced by them when on the wing is higher in pitch than that of any known bee, and their buzzing is so extremely soft that any bee-keeper, even a novice, can recognize the buzzing of the Egyptian bee from the other two kinds. The buzzing of the drones is also softer. One might say that the song of the Egyptian bee is soprano, while that of the Italian or common bee is bass.

The cells of the Egyptian bees are similar to those of the Italian bees in material, form, and position, but they differ in size. The worker-cells are visibly smaller than those of the other two races. Ten cells of Egyptian bees occupy the same space as nine of the others. The depth of the cells is also somewhat smaller. If the same distance was put between their

frames as between the combs of the Italians they would build combs between the frames.

Fourteen Egyptian drone-cells are equivalent in length to ten Italian drone-cells. The queen-cells are smaller in the same proportion. One thing is particularly remarkable. It is that the Egyptian bees build very thin queen-cells, and do not strengthen them at all until the queens are born. Another peculiarity is that the Egyptian bees construct a great many royal cells and accumulate them in groups. As many as thirty-five queen-cells have been found on a piece of comb eight inches square.

The Egyptian bees when united with Italian or black bees accept them willingly, and *vice versa*. These three different kinds of bees live in peace in the same hive, and it is an agreeable sight to see the little white Egyptian bee flying together with the Italian and the black bees.

Although the cells of our bees are larger than those of the Egyptian, it has been proved by experience that these little bees do not hesitate to deposit eggs in them; but the difference in size induces them to err, and they deposit drone eggs in them, but after a while they begin to lay worker eggs. It is also proven that the Egyptian queens do not begin to lay forty-eight hours after impregnation like the queens of the other races, but they wait five or six days.

When introducing brood combs of common bees in Egyptian hives the bee-keeper should choose the oldest combs, because the cells are narrower on account of the cocoons that have been left in them by the bees when hatching. These old cells differ but very little in size from the Egyptian cells.

It is impossible to introduce combs of Egyptian bees in common or Italian hives to re-enforce them. The following experience was made on this subject.

An Italian colony was deprived of its queen, and the brood was removed to be replaced with Egyptian brood. But the colony raised no queen-cells, and allowed all the young brood to starve. The bees sealed, however, all the cells of all the brood that had received a sufficient quantity of jelly. The reason of this fact is easy to understand. We must not conclude that there is an aversion between the races, but simply that the Italian or the common bees can not reach the bottom of the Egyptian cell on account of its narrowness.

An Italian colony was again furnished with Egyptian brood, of which the cells were not finished, but containing eggs. The bees fed the young *larvæ* and constructed some supplementary cells, but to finish the cells the bees were obliged to widen them on all sides so that each cell had the form of an hexagonal funnel.

The Egyptian workers have a great tendency to lay. In an orphan colony where brood is wanting laying workers will be found after a few days. In a population composed of the three races of bees, the little white bees are the ones that furnish the laying workers if the mother fails. This fact has no practical value; it proves, however, in favor of the prolificness of the Egyptian bee.

The honey-bee is the most laborious of all animals; the most eager to gather supplies for future wants; it is therefore given as a model of domestic economy. It is always at work, either at home or in the fields. There is a difference, however, between the Egyptian and the other kinds, when the harvest begins or when it ends.

The Egyptian bees rush out like a whirlwind. They are so light that they leave the Italians and the common bees far behind. The warm climate from which they originate has a great influence on their activity.

The industry of the Egyptian bee is sufficiently proven by the quantity of honey that it gathers. When coming back from the field with a full stomach the first rings of its abdomen are almost transparent. The pellets of pollen that they transport do not differ in size from those of our bees.

They do not use any propolis to cover the inside of their hives or to strengthen the comb. In the Egyptian hives made of dirt there is no propolis to be found. In Germany it has been ascertained that they do not gather any propolis. They use wax in the place of it for all purposes. In this they differ from our bees.

The Egyptian bees are mild in character. Bees of all kinds, and wasps, hornets, or ants, are provided with a sting. The insects generally called stingless bees, like the melipones and the trigones, are not bees, and have nothing in common with bees except the instinct of gathering honey and the faculty of producing wax.

Varieties of bees differ from one another not only in color and size but also in gentleness. The Egyptians are mild in

character, like the Italians. They sting only when irritated. When the air is warm and the temperature almost suffocating one can stand very close to the entrance of their hive and observe them without being attacked. If they are irritated either by striking on the hive or by making quick motions around them, they will draw their sting, and it is with them as with the Italians—to fly up to the enemy and sting him is all one. The sting causes pain and swelling, but the inflammation is inconsiderable; probably on account of the small size of the sting, and of the small quantity of poison absorbed in the wound.

The Egyptian bee when attacked defends itself against robbers, flies up to them and grasps them in such a way that they can not get rid of it. The Italians also can defend themselves against robbers, but the Egyptian bees have a great advantage over them on account of their activity.

When bees are in quest of honey they will take it wherever they can find it, and the instinct of hunting for it in the flowers soon induces them to steal it. Dzierzon wrote with justness that creatures deprived of reason, like bees, could not have a better morality. For bees to gather honey is to take it wherever it can be found. All races of bees have a tendency to rob. This tendency is eminently developed in the Egyptian bees. They, like the other races, destroy the drones at the end of the honey-harvest; and at that time the swarming fever ceases.

According to Vogel, from whom the substance of this article is taken, it is easy to keep this race pure; for the Egyptian queens, being smaller than the others, will choose drones belonging to their race; they can distinguish them easily by the peculiar noise of their wings.

The same writer observes that an Egyptian queen, impregnated by an Italian drone, can not get rid of the sexual organs of the drone on account of their large size, and perishes after this impregnation.

The German author writes at length on this race of bees, and on several other varieties that could be had from Egypt. But these questions being of secondary importance, I will here close this notice.

The Turks have as a saying, "You can't sweeten your mouth by saying 'Honey!'"

A FEW HINTS AND EXPERIENCES.

BY REV. W. F. CLARKE, GUELPH, ONT.

Though only one "Novice" writes for the "Annals," it may fairly be presumed that many "novices" read that useful publication, and for such especially this contribution to its pages is meant.

Many persons who have been induced to purchase movable-frame bee-hives, and put bees into them, use them just as they would the old-fashioned box or gum hives, and then complain that they have thrown away their money. Now this is very absurd. Of what advantage is an improved hive if the very improvement of which it consists is made no use of? The chief intent and value of a movable-frame hive is to give access to a colony of bees, and enable the bee-keeper to control and regulate its internal economy. But there are those who, having bought such a hive and put a swarm into it, have never ventured to open it, or to do anything more with it than they would with a box or gum. Very likely the bees, left to themselves, have built their combs "*criss-cross*," and fixed things "fast in fate," so that the hive is to all intents and purposes converted into the commonest of box hives. Then indeed is the money thrown away, or worse, inasmuch as the negligent customer vents all sorts of maledictions on improved hives and their improvers, hastily proclaiming all "humbugs" together.

A few plain words with you, Mr. Stupid. It is you who are the humbug. What would you think of the farmer who should buy a mower or reaper, and for want of knowing how to use it proclaim it an imposition, and persist in swinging the old back-breaking scythe or cradle? A million farmers ride proudly erect through meadows and grain-fields where of old they toiled and broiled, bearing the heat and burden of the day, while yonder fool still swings the scythe or cradle, though here lies in the barn-yard a labor-saving machine on which he has wasted his money, and which he can not use for want of knowing how. That fool is you. Read up on the nature and habits of bees; learn how to handle and manage them; find out what a movable-frame hive is for, and use it accordingly.

Without a doubt, fear of getting stung keeps many persons from meddling with their bees. Only here and there one has the

philosophy of that Indian who, when he swallowed a spoonful of mustard out of curiosity, forgot the pain and stanched his tears by thinking of his brave forefathers. A bee-sting is no joke when it maddens the blood into fiery inflammation, blinds the eyes, and swells the head as large as two. Besides, do we not now and then read of bee-stings causing death? It is undeniable that bees have an affinity for some persons and an unconquerable aversion to others. It is our misfortune to be hated of bees. Most faithfully have we fulfilled the Bible injunction, "love your enemies," and often have we labored to "overcome evil with good," but without avail. Bees are heathen insects anyhow. If you let them swarm naturally, they will do it for the most part on Sundays, and if the bee-master is a minister, contrive to sting him in the face, so that either he can not go into the pulpit or is made to look ridiculous there. Science is more efficacious than gospel in dealing with bees. A little smoke, a bee-veil, and gloves are better than Christian doctrine or Christian spirit for apiarian purposes. It is the ambition of many bee-keepers to be able to handle their bees without protection. Some hardly ever get stung, and others do n't mind it, being pachydermatous and invulnerable. Must bee-hated people forego the interest and charm of an apiary? Not when the remedy is so simple, say we. Bees are fickle and notional. They have their moods, like verbs and men. We have handled ours without protection frequently, and found them as amiable as lambs. Again, we have handled them with the same gentleness and care, and found them cross as hyenas. Finally we have settled down to the pleasant custom of having a veil round our hat ready to drop, and gloves at hand ready to put on when the angry mood seizes the bees. And we advise all bee-keepers with whom the little insects are not in league and in love to adopt similar precautions. Gallup, Hosmer, Bohrer, and Mitchell (who is Egyptian-bee proof) will laugh at this counsel; but we can 't see where the laugh comes in. Once a couple of bee-stings on our right hand disabled us from writing for a fortnight—a bad predicament for an editor. A friend of ours, Judge M., who is an enthusiastic bee-keeper, once tripped his foot when among his bees and knocked over a hive. The enraged insects came at him like furies. Fortunately the grass was long, and there was a large evergreen close by, well furnished to the ground. The judge dropped down among the grass, and put his head among the foliage of the evergreen, and for four mortal hours,

until evening set in, the bees kept him prisoner. When he found himself a fixture he improved the time by studying up some law cases; but ever since he has believed in veils and gloves. While on this subject let us say a veil of some black material is best. Happy is the bee-keeper who can get possession of an old-fashioned black-lace veil. It is just the thing. For gloves nothing is better than the sheepskin gauntlets used in harvesting where thistles abound. They cost only about fifty cents, and with care will last a life-time almost.

A word about bee-houses. Some of the bee-books, especially the English ones, contain very pretty plans of bee-houses, and early in our experience they tempted us into building the like. But we found them a perfect nuisance. They harbor moth-millers, toads, mice, and spiders. The close proximity and similarity of the hives confuse the young queens when they return from their bridal excursions, and cause loss; the very workers are nonplused often, and many a civil war is the result. Robbing is more prevalent when the hives are huddled together, as they must be in a bee-house. If a single hive becomes excited from any cause, all the adjacent hives quickly sympathize, and the place gets to be a perfect pandemonium in no time. Hives should stand isolated, at least eight or ten feet apart. It is well to paint them of different colors, that each may readily be distinguished. A little village of hives, located in a sparsely planted shrubbery, where partial shade is given them, looks very pretty, and is much better for all practical purposes than the most artistic and architectural bee-house ever erected.

Bee-keepers who use the mel-extractor should provide some place inaccessible to the bees in which to work it; otherwise there will be more honey extractors in operation than will be pleasant. A tent or canvas-house is recommended by some. Our plan is to use the winter bee-cellar as a summer honey-room. It is an apartment eight by sixteen, built across a wing of the house, where from the sloping nature of the ground the sills are four feet above the level. Four feet more of excavation gives ample head-room. The walls are double-boarded and filled with tan-bark and saw-dust. A wire-cloth door at one end and a window of the same material at the other give ample ventilation, exclude the bees, and the place is a nice, cool room for extracting and storing the honey in the summer time, while it is easily fixed up for winter quarters.

We intend, about the first of March, to try the effect of stimulation on all our stocks by feeding them *a la Hosmer*. Oh, for a fifty-acre linden wood!

APICULTURE IN AGRICULTURAL COLLEGES.

BY PROF. A. J. COOK, OF THE MICHIGAN AGRICULTURAL COLLEGE.

It was a satisfaction to us of the Michigan Agricultural College, who have thought apiarian science of sufficient importance to well merit a place in our curriculum, and who, I believe, are pioneers in introducing it into a college course of study, to notice the resolution offered by Mr. Cameron, of Washington, at the recent meeting of American Apiarists at Cleveland; and also to notice its hearty adoption by that most intelligent body, composed of such persons as Quinby, Clark, Root, and others.

It is certainly a suggestive fact that practical apiarists of such intelligence should demand for the science of bee-keeping a place in our agricultural colleges; especially as these institutions are endowed by the Government for the very purpose of promoting knowledge in respect to rural pursuits. No wonder that men made purer and better by influences which come from familiarity with this wonder of insect life—"the honey-bee"—and whose pockets swell with the rapidly accumulating proceeds from their marvelous stores, should object to seeing this most profitable branch of husbandry ignored by the authorities of these institutions.

We think that the adoption of this resolution was most opportune, and hope that it will be effective in its object. When we reflect that nearly all of our agriculturalists still keep bees under the old regime of box hives and no attention, and whose cash to balance is more apt to be on the credit than on the debit side of the account; while the few who have made the subject a study, using science and other's experience, and giving a generous margin to that slight attention necessary, have made regularly from one to three hundred per cent. from their capital invested; we feel that no agricultural college ought to neglect this branch of instruction.

Why, it is a fact that all of our farmers who fully understand the economy of the hive pronounce "bee-keeping" the most prof-

itable and least laborious branch of their business; and it is only because of lamentable ignorance on the part of the farming community in respect to the "mysteries of bee-keeping" which keeps from our national wealth the millions of dollars which, with knowledge, will come from the flowers, through the agency of the honey-bee. If our farmers only knew that they too, as well as Marvin, Hosmer, Grimm, and others, could make their thousands annually, and with so little labor, how quickly would systematic bee-keeping become prevalent throughout the country; and the farmers are all eager for information, but with no teachers, many cares, and past box-hive failures, it is slow to come.

Now right in our agricultural colleges is the place to remedy this evil. If all these institutions will send forth yearly a score or two of young men, fully taught as to all the improvements of bee-keeping, stimulated by a knowledge of its great profits and little labor, and qualified for success by having actually handled bees in all the varied manipulations of a well conducted apiary; why, have we not here alone leaven that will soon leaven the whole lump? and here alone an increase in national wealth that will soon repay the amount of endowment by which these institutions were created?

I have never known students more enthusiastic than in gaining knowledge on this very subject. They are most careful not to give the go-by to a single idea advanced in the lectures. And with such an example as we gave them this past summer, of a net profit of over two hundred per cent. on the money invested from our college apiary, though experimenting somewhat lessened our honey yield, we think they will go forth prepared to stimulate the farming communities to that interest in bee culture which shall lead to thorough knowledge and consequent success, which is sure to follow an intelligent practice of this pursuit, whose fascination is only exceeded by its profits.

Bee culture is in its infancy; yet there are many persons who proclaim perfection. The truth is that there is nothing we know all about. Perfection has not been attained in any of the sciences, much less in bee culture, that but a few years ago was wrapped in mystery and superstition. Of the physiology of the bee we know but little except from inference; of its labors we are just beginning to learn. We see results, but know little of how they are attained. Of diseases we know almost nothing. Yet with all this we have obtained great results.

PARTHENOGENESIS IN BEES.

BY A. S. PACKARD, JR., M. D., SALEM, MASS.

Are the drone progeny of an Italian queen fertilized by a black drone in any way affected by the cross? My answer to this question is drawn from the facts discovered by Dzierzon and Berlepsch, the two greatest bee masters in Europe, and confirmed and further illustrated by Siebold, the eminent German physiologist and anatomist, in his little book on "Parthenogenesis,"* which should be in every bee-keeper's hands. And if a perusal of this little work would stimulate our more intelligent bee-keepers to study and experiment for themselves upon this anomalous mode of generation, much more light would be thrown upon the theory and practice of bee-keeping. The physiological knowledge needed to start with, if from no other source, could be readily obtained from any physician.

The discovery of Dzierzon, that "*all eggs which come to maturity in the two ovaries of a queen-bee are only of one and the same kind, which when they are laid without coming in contact with the male semen become developed into male bees, but, on the contrary, when they are fertilized by male semen produce female bees,*" may be taken as an axiom.

It is well known also that worker-bees sometimes lay eggs which produce drones; the workers are incapable of being impregnated by the drones, the oviduct being imperfect, and the seminal capsule adapted for storing up the seminal fluid in the queen being small and undeveloped, while the bees themselves feel no sexual impulse and take no marriage flight in the air.

It is also an established fact, I believe, that "a queen may acquire the power of laying fertilized eggs for five years by a single normally executed copulation." The queen is never impregnated but once.

Again, Siebold ascertained that the eggs of the queen when passing through the oviduct are impregnated by the male semen

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* On a True Parthenogenesis in Moths and Bees; a contribution to the History of Reproduction in Animals. By C. T. E. Von Siebold. London: Van Voorst. This work can be obtained through the American Naturalist's Agency, Salem Mass.

just when they slip past the opening of the seminal capsule; at this time she allows one or more spermatozoa to slip out; these immediately work their way into the yelk of the egg through the "micropyle," or minute hole in the end of the egg, and then the egg is fertilized and the life of the embryo at once begins. The orifice of this seminal capsule is controlled by voluntary muscles, so that the queen lets a seminal filament slip out at will. When an egg destined to produce a drone passes by the queen does not allow the seminal filaments to pass out. Siebold invariably found spermatozoa in the eggs of workers and queens, but never in those of drones.

Thus it may be received as an axiom that "*every normally organized and fertilized queen possesses the power of laying male or female eggs at will;* that is to say, of leaving an egg unfertilized or depositing it fecundated, at will, when engaged in laying her eggs."

Siebold also found "that by the copulation of insects the *ovaries* are not fecundated, but that the seminal receptacle is filled with semen, and that the fecundation of the egg only takes place at the moment when the egg to be laid slips by the orifice of the seminal receptacle in the oviduct."

That the ovary itself is not affected by the impregnation is proved, I think, by Siebold's statement that "those female insects which after the completion of copulation survive their males in the autumn hibernate with the ovaries imperfectly developed, and only lay fertilized eggs capable of development in the following spring, after their ovaries have become filled with mature eggs." Such is the case with the humble and other wild bees, the wasps, and many other insects. So that it seems thus far to be proved that the spermatozoa introduced into the seminal capsule by the male never pass out of it again, unless subject to the will of the queen.

It results from these facts that the drone progeny are in no way influenced by the father of the workers and queens produced at the same egg-laying. To return to our question then, whether the "drone progeny of an Italian queen fertilized by a black drone are in any way affected by the cross?" I should answer that they are not; and I believe such would be the answer of any one conversant with the facts established by practical bee-keepers and scientific physiologists.

Siebold also tested the truth of his independent investigations by the results of hybridizing Italian and common German black bees, frequently practiced by bee-keepers. He says that if the theory of parthenogenesis is correct, "we might beforehand expect that by the copulation of a unicolorous blackish-brown German and a reddish-brown Italian bee, the mixture of the two races would only be expressed in the hybrid females and workers, but not in the drones, which, as proceeding from unfecundated eggs, must remain purely German or purely Italian, according as the queen selected for the production of hybrids belonged to the German or Italian race." And in fact such he found to be invariably the case. It is evident, however, that these experiments must be made with the greatest care, and of course the queens must be full-blooded—*i. e.*, of pure race; and, as Siebold remarked in 1856, "the observations will have to be made only with individuals of a perfectly pure race, which will not always be obtained with ease and certainty, since the breeding of the Italian swarms side by side with the German bee-hives is already carried on amongst us to a very great extent. How difficult it may be to find a perfectly genuine and pure queen for such experiments is shown by the mixtures of two races of bees," to which he previously refers. Further on he quotes the statement of Berlepsch, that "all queens *which are of a beautiful yellow externally only produce Italian drones*, even when they produce partly Italian and partly German workers."

A German mother, which was fertilized by an Italian drone, produced German and Italian workers, *but only German drones.* When, on the contrary, the mother is not of a fine yellow, when she has traces of black blood in her, the drones also come forth mixed, whether the mother be fertilized by a German or Italian male; of course, because the males only take after the mother." Siebold then adds that from the observation of a great number of productions of hybrid bees "it must therefore be regarded as certain that, in accordance with Dzierzon's theory, bees of pure race are deprived of the power of producing hybrid drones."

I think then that the question at the head of this article is fully answered in the negative. It should be borne in mind that queens of pure race are difficult to be obtained, and hence their drone progeny are impure; so that to most bee-keepers the result of a cross between an ordinary Italian queen and a black drone may be impure.

ARTIFICIAL COMB.

BY M. QUINBY, ST. JOHNSVILLE, N. Y.

Can it be made? Will the bees accept it? Will it pay to make it? Before we can comprehend the advantages of artificial comb we must ascertain, as far as practicable, the cost of wax, or natural comb.

It is said that a swarm of bees will consume not far from thirty pounds of honey in secreting wax to fill an ordinary hive with combs weighing a little more than one pound when new. Assuming that it is correct, we can not estimate the honey consumed worth less than three dollars at the lowest rate possible. We must not lose sight of a more important consideration in our estimate. Bees do not build comb except during a honey-harvest. We want now to ascertain, if possible, how much honey the bees that are engaged building this comb would accumulate in this time, providing there were empty combs ready made to receive it as collected. I have weighed strong swarms in box hives, part full of comb, during a full yield of buckwheat. In seven days one hive gained twelve pounds, another sixteen pounds, another in twelve days gained thirty pounds. During clover blossom a new swarm gained forty pounds in fourteen days. None of these exceeded three pounds per day. We have reports of greater gains per day, but probably it was the result of double swarms. On the other hand, we have known a strong swarm, when empty combs were furnished, to collect over eighty pounds in one week. Forty and fifty pounds in a week is quite common. Mr. Hosmer reported fifty-three pounds in one day. From this it would appear that during a yield of honey the average gain from having combs furnished would be not less than forty pounds per week over what it would be if the bees had to build them. This in the two weeks that it takes to fill the hive with combs would be eighty pounds. Add the thirty pounds consumed to secrete the wax, it amounts in the aggregate to one hundred and ten pounds while filling the hive. At ten cents per pound, we have eleven dollars cost to fill an ordinary hive with comb. I presume that many would have rated the expense much higher than I have. But whatever it is, we want to see if economy will allow us to make it for them. Gen. Adair stated at the convention at Cleveland that by furnishing the bees with wax mixed with sugar they would manu-

facture the combs and do it at a season when no honey was to be had in the flowers. If they will do this to the extent that we want comb made, we shall easily save very much more than half the expense. This process will soon be further developed. All wax-combs are subject to injury from the moth-worm. They make a passage through the center, which the bees remove if they are strong enough; if not, it remains to spoil the hive. To remove the silken gallery in the center of the comb about three rows of cells must be cut away and built anew; an additional and continual expense with all wax-combs, perhaps equivalent to a complete renewal once in five or six years.

Until the present time all attempts to make artificial comb have failed, except a few cells. Nothing of practical value has been produced till now. Combs have been made of tin cells of full depth, coated with wax, and are readily accepted by the bees, using them both for storing honey and raising brood. The actual cost per square foot is not far from $1.50. Nine square feet is enough for a common hive, which would make the first cost considerably more than the same amount of wax-combs. But as this may be considered everlasting and the other to be often renewed, it is a question yet to be decided which is the cheapest.

The tin combs are made in parts, and when they become filled with cocoons, bee-bread, etc., the parts can be taken down, boiled clean, wax-coated again, and set up as good as new. A patent has been applied for, and is yet pending. As this is the first practical artificial comb yet made, it was supposed that the field was clear; but Mr. Wagner, ten years before, had obtained a patent on what he termed foundation-comb, which consisted of thin sheets of wax pressed into the shape of the bottom of the cells. This was offered as an objection, claiming that the "foundation" anticipated the full-depth cell. Whether patented or not, no claim to a prior discovery will probably be made for full-depth cells. If some benevolent bee-keeper can discover some material as indestructible by the worms as tin that can be furnished at less cost, and at the same time acceptable to the bees, and is willing to share the advantages with all, he will put us all under lasting obligations.

Gentleness and boldness are two important requisites in handling bees. These, with knowledge and industry, will make a good bee-keeper.

THE SOUTH AS A BEE COUNTRY.

BY S. W. COLE, ANDREW CHAPEL, TENN.

In keeping bees for commercial purposes on an extensive scale, the production and sale of honey will ever be the principal object of the apiarian. In the "coming time," which we trust a decade or so of years will usher in, when honey will have largely taken the place of molasses in commerce, and the price of it will have settled down to a low and uniform standard in all the markets, favored localities for bee-keeping will then be sought for and appreciated more than at present.

It has been the history in the rise and growth of all great commercial products that when their production has become extensive enough to affect the commerce of the whole country, while many localities could produce them, districts favoring their cheap and easy production have always taken the lead and held a kind of monopoly in the production of those particular classes of products. This has been notably the case in fruit-growing, in stock-raising, and in wheat and cotton-growing. While we hold that it will always be profitable to keep bees wherever honey can be gathered, the fact is evident that it will pay much the best if they be kept in a good honey district.

In that "coming time" when our country will be so intersected with competing lines of railroads, and freights will be so reduced as to enable distant sections to exchange products with each other, or to ship them to the great commercial centers of the country at a merely nominal cost; when high prices at any point will be impossible on account of the cheap and superior facilities of transportation; then, if not before, the South as a bee country will receive the attention of apiarians it so richly deserves.

Bee-keeping, as a business to be made profitable, must receive our whole attention, and it is useless to expect the highest results from our bees unless they be kept where forage is abundant. We do not wish to discourage artificial pasturage; this is certainly good as far as it goes; but it appears to us that it is only advisable where bee-keeping is a secondary consideration, and the bee-keeper has other occupations to confine him to that particular locality. But if we wish to engage in bee culture as a specialty, it has always appeared to us to be much better to go at once to a good honey-producing district than to spend years, or perhaps

nearly a life-time, in the vain endeavor perchance to raise orchards of honey-producing trees in soils or localities uncongenial to their growth. And if this should meet the eye of any devoted bee-keeper engaged in the up-hill business of raising miniature bee-forests, we really hope that he will give it up at once, and move bees, traps, and all to Kentucky, Tennessee, Arkansas, or Missouri, the real bee El Dorado of America. The southern bee-keepers have many advantages over their northern brethren. Our mild winters dispensing with all necessity of indoor wintering, and our earlier and longer seasons giving us superior advantages in securing surplus honey or in the multiplication of colonies. The season of 1870 was the first failure in the spring honey-harvest known in my locality for twenty years past, while we have an almost absolute certainty of an abundant fall harvest every season. In putting our bees into winter-quarters in the fall our greatest trouble has always been to find enough empty combs for wintering.

It is true that our southern honey has not heretofore ranked as high as northern honey in the northern markets; but it has been owing solely to the fact that it has generally been shipped in bad condition and in unsightly packages. If handled with the same care, and if put up in the same showy form, if from the same sources of pasturage, we defy any one to distinguish it from the best northern honey.

If our northern brother bee-keepers could but get a sight of some of the forests that border our river courses in the south, and could see the wilderness of maples growing there, while the banks of the small creeks and bayous for miles are lined with a perfect hedge of willows; and back from these, and bordering on them, the woods are darkened into semi-twilight by the thick evergreen foliage of the holly—another splendid bee-plant—and as you ascend to the upland you would find forests of giant old poplars, interspersed now and then with the stately bass-wood, while the wild grape-vines form a net-work of the undergrowth, or swing like great cables from the tops of trees a hundred feet high; while on the edge of the bottoms bordering these forests will frequently be found clearings of a hundred acres or so, done under the old regime, but now abandoned for want of labor to the undisputed possession of the blackberry, and of the whole family of asters and golden rods; they would say, as we do, that with all its other blessings it is certainly the paradise of bee-keepers.

THE LABORATORY IN THE BEE-HIVE.

BY D. L. ADAIR.

"One drop of water hath no power; one spark of fire is not strong; but the gathering together of waters called seas, and the communion of many flames, do make both raging and invincible elements. And *una apis, nulla apis*, one bee is no bee, but a multitude, a swarm of bees, uniting their forces together, is very profitable, very comfortable, very terrible; profitable to their owners, comfortable to themselves, terrible to their enemies."—PURCHAS.

The state of rapid advancement in which the science of bee culture now is, is no doubt based on solid facts; but until those isolated facts are understood in all their bearings on each other, we must consider it in its infancy. If what little we know of the actual laws governing the actions of the honey-bee has enabled us to accomplish so much, what may we not expect when research has brought to light and unfolded all the hidden mysteries of the hive, and arranged them in a perfect system. It is probable that not far in the future we will look back upon our present knowledge of the subject and wonder at the narrow sphere to which our knowledge is confined, as we now do when we look back a few years and see the ludicrous superstitions that then formed the basis of the science.

In America, until very recently, bee-keeping has been considered too trivial to enlist in its investigation men of science, but it is to be hoped that the time has passed in which it was so viewed, and that it will hereafter be dignified with the position it deserves; and that when science is brought more fully to bear upon it, it will unfold to us more of the principles governing the labors of the most wonderful of insects.

Until that is brought about we must be satisfied with what we know and can learn, but not follow the example of many by concluding there is no necessity for further progress.

There are many important points of which we have but a glimmering, that would be clearly perceived if we had a more perfect knowledge of the economy of the hive from beginning to end. Without arrogating to ourself the knowledge and capacity to unravel all the mysteries, we have written what follows as our

convictions, and have attempted to follow a colony of bees from their swarming and being hived through all of the labors of the hive.

If we hive a natural swarm of bees in an empty hive, of such construction that we can observe and closely watch their work, we find that they suspend themselves from the top of the hive, or chamber, in which they are placed, in as compact a form as possible, appearing as an inverted cone; but in reality the true, efficient, active force is composed of bees in the shape of a sphere, or ball, the bees forming the inverted base being stationed in that position for the purpose of suspending the true cluster.

By a close observation we will find that the outside bees of the cluster are not a part of the active force, but form a crust inclosing the active cluster; in fact, they and the suspending bees form a natural hive, inside of which the organized forces are working. By taking a small stick or wire and passing it horizontally and suddenly through the middle of the cluster and letting all below it drop, we can, by looking quickly, see that the solid wall of bees is not exceeding an inch and a half in thickness, while inside it is not at all crowded, but that there is a hollow about three inches in diameter, and no more bees inside of it than can work on the new comb-structure.

They commence working at the point where the circumference of the hollow sphere touches the top of the hive, by forming a narrow neck of comb, at first not more than three or four cells wide. This they carry down, slowly widening, but rapidly lengthening until they reach a point exactly at the center of the hollow. Here they establish a center from which they work. Cells are built in a circle around this center, and it soon becomes the widest part of the comb; but as it widens and thickens it gets heavier, and would break down if the stem were not strengthened, so that it gradually widened until the comb at the center is about three inches wide, when the neck is equally widened.

The edges of the comb now touch the inside of the crust, and the crust recedes. Just at this time two parallel sheets of comb are begun, as before, and are run down opposite the center. When the first cells on the stem are about one eighth of an inch deep the bees begin to place honey in them, and continue to fill them as they are built up until they get within one or two inches of the center; below that they place no honey.

But as soon as the central cell is one eighth of an inch deep

the queen lays an egg in it. She then goes around on the opposite side and lays eggs in the three cells that are built from the base of the central one. She then returns and deposits eggs in the six cells surrounding the first one, and continues to keep the cells on both sides filled with eggs as fast as they are ready to receive them, thus establishing the center of her brood-nest at the center of the comb-structure; and when the comb on each side of the first is brought down opposite the center she embraces them in her circuit, thus giving her brood-nest a globular form.

The honey-storing bees keep the store-cells above filled with honey down to the brood. As the sheets of comb are widened they come down lower, and as each additional comb-sheet is built they occupy more of it, thus storing the honey in an arch or dome over the brood.

The work thus progresses, and will continue in the same order for twenty-one days, if the space be large enough; at which time the brood-nest attains its full size; for at the expiration of that time the cells in the center first filled with eggs are vacated by the maturing bees, and the queen returns to the center to refill them with eggs; and as they are emptied in the same rotation in which they were filled, she continues to follow them up, going over the same ground every twenty-one days.

The completion of the brood-nest does not stop the comb-building. That continues as rapidly as ever; but, as it is not filled with eggs by the queen, the honey-gatherers keep it filled with honey, thus surrounding the brood with honey.

Let us now examine the comb that has been constructed, and we find that all of the cells embraced in the brood sphere are of a regular size, and is all worker-comb. The cells in the upper part, filled with honey, are most likely a size larger, and frequently irregular. So far there is no drone-comb.

Around the brood-nest on every side, and below, there is found a border of cells that are neither filled with brood nor honey, but are partly filled with bee-bread.

Let us again accompany the queen on her circuit and note what occurs. The first bees that emerge from the cells remain on the sheets of comb that reared them. For three days they eat nothing. Their alimentary organs are not matured, although their stomachs are filled with food which they received in the larval state. A part of this is taken up by the circulation, and is used in completing their internal organism.

At the end of three days the eggs laid in cells from which they came hatch, and the young bees disgorge the remaining contents of their stomachs into the cells as food for the young larvæ. They then begin to eat the bee-bread that we have said is placed around the brood-nest on all sides, which is taken into their stomachs, and after being partially digested is given to the larvæ. For about four days, or a little longer, they continue to feed the larvæ; their growth being then completed, the nurse-bees begin to eat honey sparingly, and become wax-workers.

The bee-bread and honey they consume is no longer disgorged as food for the larvæ, but is thoroughly digested, and in the laboratory of their stomachs is changed into wax, which is secreted in glands perhaps, from which, as it hardens, it finds its way into the wax-pockets under the abdomen. The first formed is perhaps used to cap over the larvæ they have been nursing. This period does not necessarily limit the capacity of the young bees as nurses, but it is probable that they can perform that office as long as they continue in their adolescent state, and are eaters of bee-bread; but the food not given to the larvæ is converted into wax.

As the wax accumulates on them, they gradually, following the course of the queen, recede from the center, and find room on the outskirts of the comb-structure for depositing their wax.

The bees that have been comb-building up to this time pass out into the fields as gatherers of honey, to be stored in the comb as built by the new wax-workers; the latter, after passing their allotted time in that mechanical labor, in turn becoming honey-gatherers, and after laboring in the fields for about a month and performing duty as crust-bees, die of old age.

We thus see that there is a perfect system governing the work of the bee; that, contrary to former notions, which supposed that the different offices of the bee were directed, as a system of police in a government, by a head, and were executed by the exercise of reason and discretion, they are involuntary, and each bee in succession performs all the duties. As it increases in age it is crowded outwardly by the development of others in the center. From a nurse in the brood-nest its labors are first transferred to the wax structure; thence to the gathering and storing of honey; and when it is no longer of use as a productive agent it takes its place in the living wall that protects what it can no longer produce, and finally is cast off like the withered leaf.

So far we have gone on the supposition that there was room for the bees to extend their work in every direction, except up. But as that is seldom the case with the bees in hives, let us consider the effect of a failure of room in any direction. We have said that when the cluster is first formed a part of the bees form a living hive or crust around the hollow in which the first work is done, and that as the comb-building progresses they recede before it. This they continue to do, swelling out like an India-rubber balloon as it is inflated with air, always encompassing the comb. They are the hive proper. The bees claim no occupancy of any other part of the hive, be it large or small, than is inclosed inside of this globular crust.

This living crust has its analogy in other hymenopterous insects—for instance, the papery nest-covering around the brood-nest of the hornet (*Vespa crabro*)—which, simultaneously with the building of the first brood-cells, has its commencement, and soon assumes the shape of a globe surrounding the cell-structure of the nest. As the number of galleries and additional comb is built, it is enlarged until, from a ball the size of a boy's toy, it attains near a foot in diameter. The hornet not being accompanied by a host of animals out of which to form a living wall, nature provides an instinct to produce a substitute in a paper crust that protects the nest.

We will now suppose the bees to be placed in a hive ten inches deep, thirteen inches wide, and two feet long, and that the cluster is formed in the center of it each way. In an ordinary-sized swarm the brooding center will be placed three and a half inches below the top; and if the comb be built across the hive, it will be equidistant from the sides and bottom, so that when the first sheet of comb is extended six inches from the center each way it will have reached within one half inch of the sides and bottom, which is as near as the bees will approach with brood-comb to a solid wall. The store-comb above will be joined to the sides.

The crust, having receded to the wall and bottom, gives way and is broken; but as the solid walls and bottom of the hive take its place no harm is done. Lengthwise of the hive the circle has been maintained, and the eighth and ninth sheets of comb have been commenced, which are twelve inches apart. Around them the crust is maintained. The cluster can extend no further laterally, and is forced out toward the ends. The cluster is divided

into two hemispheres, and the work extends toward the ends of the hive, pushing them before it.

If there are any cracks or openings in the evacuated territory too small for a bee to pass through, they are carefully stopped up with propolis, as to leave them behind would disorganize the harmony of the operation. If large enough for a bee to pass through, a part of the crust-bees are left to stop them with their bodies, many of them passing to the outside. If there are holes in the ceiling or top of the chamber, they are managed in the same way.

Thus the work progresses until the hive is filled with comb, brood, and honey, the crust finally giving way, and leaving none thus engaged except such as are guarding the openings.

Then if there be honey-boxes on top of the hive many of them will pass into them; others will be forced out at the entrance-holes, and "hang out," as it is called. The wax-workers, having no further work, follow them, and when enough join them in the boxes they suspend themselves to the top and reorganize as an independent cluster in each box, and go to work as they did in the beginning, the same process of comb-building being repeated in miniature by each cluster, with this difference, that the queen being left in the brood-nest below, the cells are not filled with brood, but are occupied with honey. Each cluster being small and disconnected, the whole of them fail to progress as rapidly as they did in the continuous chamber.

Before considering the effects of the disorganization let us go back to the cluster as first formed, and see if we can learn anything of its objects. In order to do so let us place two thermometers in the hive, one outside of the crust and the other inside of it. The one inside will indicate a temperature of 70° Fahrenheit; the other will show a temperature different, depending on the temperature of the atmosphere. We will also place in the same manner in the hive two hygrometers. (The hygrometer is an instrument for measuring the moisture of the atmosphere.) The one inside of the cluster will mark the atmosphere dry and fail to indicate the presence of moisture; the one outside will mark a degree of moisture as influenced by the outside atmosphere, augmented by the exhalations from the cluster.

Other phenomena are observed of which we will not now speak, these being sufficient for our present purpose. From the

observations here laid down we think we are justified in the following conclusions, the substance of some of which we have published before:

1. A colony of bees is a unit. Each bee is but a member of the whole body, and not separate and individual, any more than the fingers of the hand or the buds on the tree. The nerves that connect the fingers with the controlling intelligence of the body are palpable and easily realized; but the bee, as a part of the colony, is connected with the controlling intelligence of the hive by an impalpable and invisible agency, which is as perfect as the nerves of the human body. A bee separated from the colony, beyond the influence of this agency, is as useless as the finger separated from the body, and as surely perishes. Upon no other hypothesis can we satisfactorily account for many of the operations of these insects. It will not do in the face of facts to say they are endowed with reason, or that they are capable of education; for all they do is governed by unvarying laws as certain as the law of gravitation or any other law of nature. They would be useless to man were it otherwise; for did they exercise a will, and had they a discretion or reason they could not be depended on to do the same thing always alike, as they invariably do under like circumstances, and it is only by understanding and taking advantage of these fixed habits that bee-keeping has progressed so rapidly.

2. A normal colony of bees consists of a queen and workers; and nothing but worker-comb is ever constructed in the brood-nest or, near it, laterally or below, as long as there is no disturbance of the balance or harmony of the hive.

3. The construction of drone-comb and queen-cells is never carried on when the balance is perfect, but is always the result of disorganization or some disturbance of the harmony of the hive.

4. The presence of drones in a hive is always an indication that the true normal balance has been disturbed, and that the regular working of the colony has been interfered with.

5. So long as there is a vigorous, fertile queen, well supplied with worker-cells in which to deposit all her eggs, with no more young bees than can be employed in feeding the larvæ, the elaboration of wax, and building of comb, neither drone-comb nor queen-cells will be constructed; nor will the queen lay eggs in drone-cells that are already built, provided the hive is of such a construction as will allow the bees to form their cluster as a unit.

As we have seen, the natural cluster is in the form of a globe or ball, with the necessary bees to suspend it; but if the hive is too narrow or shallow, they will be drawn out to greater length, but will not have their harmony interrupted until the cluster crowds against some side, top or bottom, in which there is a hole through which they can pass. It matters not whether the opening leads out into the open air or into some adjoining chamber or honey-box; the unity is thereby broken up, as a part of the bees are cut off from the main body, and to that extent the colony is disorganized.

6. That the theory of ventilation of the hive, in summer as well as winter, most generally received, is injurious; for any air-hole into a hive full of comb, and in which the natural crust is superseded by the walls of the hive, although it is covered with wire-cloth, places the colony in an abnormal condition, and nature makes the same effort to close it that she does when the bark of a tree is pierced; and the bees work diligently, if not always successfully, in plastering it over with propolis.

7. A hive so constructed or managed that all the bees of a colony can have at all times ample room to maintain their normal relative positions, and which is kept supplied with a vigorous queen by the bee-keeper superseding the old queen whenever she shows signs of decline, and in which no violations of the theory here laid down are committed, will never have in it any drones or drone-comb, will never attempt to raise a queen, and consequently never cast a swarm. The wax-workers will supply all the comb needed for brood and honey, the maximum of strength will be kept up, and the only reasonable limit to the amount of surplus honey will be the amount of the supply in the flowers.

The periods here given as governing the different operations are necessarily variable, as they depend on circumstances not named, but are about the average, in a normal colony, during the honey-harvest. We have reports of the Italian bee reaching its imago state in eighteen days, and in other instances it is lengthened to twenty-four; but, as we conceive, these fall under the head of irregularities, and indicate an abnormal state of the colony.

For a fuller elucidation of this theory the articles entitled "Why do Bees construct Queen-cells?" and "The Genesis of the Honey-Bee," should be read in this connection.

DOES A QUEEN STING HER ROYAL RIVAL?

BY MRS. ELLEN S. TUPPER, OF IOWA.

This is a question which I would like to have answered by any one who has any knowledge of the matter. We find interesting accounts of the battles of rival queens in works upon the bee, but we find also various other things given as facts which our observation does not confirm as such. Has any one now rearing queens, and constantly familiar with the interior of the bee-hive, witnessed these "terrible combats?" In over twelve years' experience in this particular branch of bee-keeping I must say I have never had any proof that a queen's sting was used for any such purpose.

I have several times been stung by a queen; in every instance it has been a black queen that I was handling roughly, perhaps holding in my hand for safe-keeping while closing a hive, not caring if I did hurt it, only anxious to prevent its escape. In one instance of the kind the sting of the queen was left in my hand with the entrails attached, precisely as is often the case with the sting of a worker. We know that a strange queen is in danger when entering a colony, but does not her danger arise from the disposition of the workers rather than the animosity of the queen of that hive? It would seem so from the fact that she is in quite as much danger if put into a queenless colony, unless they are prepared for her reception. Perhaps the facts in this case have very little value practically, but to the naturalist it is important that truth, not fiction, be his basis of opinion.

I have times without number seen the worker-bees injure a queen in various ways, by hugging, by biting, and by stings. I have repeatedly found several stings in the body of a dead queen, but I know they were the stings of workers, not royal stings.

We have in works upon the bee homilies upon the wisdom of nature which so arranged matters that both queens could not sting at the same time, and so the life of one was preserved. But these "naturalists" do not tell us by what miracle the life and value was preserved of the queen who *used her sting upon the other*. It seems to me, after a careful microscopic examination of a queen who had left her sting in my hand, that the loss of a portion of her entrails, and as it appeared to me, the mutilation

of her ovaries, would have destroyed her value if not her life. I confess I can not understand why the loss of a sting should cause a *worker's* death and leave a queen uninjured.

I have many times seen a queen running wildly about a comb in great excitement while the *workers* were destroying royal cells, but have never seen her touching them herself. I have also repeatedly seen five and six young queens newly hatched quiet on a frame while the workers were destroying royal cells. In one case I kept four a week, or until the first one was fertilized, in safety in one hive, the bees paying them no more attention than if they were workers. I know this is uncommon, but similar instances will no doubt come to the remembrance of all queen-rearers. Surely, in the many instances we can all recall where queens have been destroyed by *queenless* colonies, there was no queen agency, directly or indirectly, in the matter.

So far as my experience throws light upon the matter I am of the opinion that these "combats" belong to the same class of facts as does the old assertion that queens are "fertilized invariably high up in the air." "Presumption" though it is called to withhold our belief from such facts, there are some of us "living to learn," and learning every day, who prefer to trust our own eyes rather than the evidence given by a blind man who, wonderful as was his knowledge, was obliged to trust much to the observation of uneducated eyes.

WHAT ARE THE MOST DESIRABLE IMPROVEMENTS IN BEE CULTURE.

BY CHAS. DADANT, HAMILTON, ILLINOIS.

For the last few years the genius of the American bee-keepers have been traveling so fast in improvements of hives, more or less rational, that it is perhaps time to stop and look backward to see if there are not some untrodden paths to be discovered.

In this article I propose to draw their attention to two subjects of the first importance to them: 1. The improvement of honey-producing plants; 2. The improvement of the honey-bee.

Man has at length ceased to consider himself the fallen being that he did during the first centuries of Christianity. He knows now that far from being inferior to what he was in the beginning, every day adds something to his ideas, to his intellect, and to his power. He knows that if he has so long been poor and feeble and a coward, it was because he was but obeying the law of all beings who, on the threshold of life, have everything to learn.

His doubts and his fears now vanish before him. He begins to know himself and his powers, and is certain of triumphing over difficulties. He has discovered that he is the king, the master, of all the beings that surround him. He knows now that he can model them at will. Out of thorny bushes he has made countless varieties of pears, apples, plums, peaches, etc. The most insignificant flowers have been forced to enlarge their corollas and change their colors to please his eye. The vegetable kingdom has been compelled to submit to all his exigencies, either for ornament or usefulness.

It is therefore with perfect confidence of success that I propose to the bee-keepers to require from the red clover shorter corollas than it has at present, in order that the bees may gather from its flowers the abundant treasures of honey that has so long been locked up from them.

Billions of pounds of honey are lost every year in the red-clover blossoms. This honey man can appropriate to himself if he so wills. There are several ways to attain this end.

1. Selection. By selecting such clover-heads as the bees have been seen to gather honey from, saving the seeds and sowing them separately in dry and infertile soil.

2. Hybridization. By trying to cross the red clover with white or alsike clover.

3. Analysis. As each part of a plant is composed of different elements, by having a skillful chemist to analyze separately the leaves, stems, and corollas of the clover it could be found out whether the corollas do not need a certain element not necessary to the development of the other parts of the plant. By cultivating clover in the same field for years and giving back to the ground all the elements necessary to the growth of the plant, but withholding such as are necessary to the formation of the corollas.

By some of these means we may be able to create a variety of clover as advantageous to the bees as to cattle.

The power of man is not confined to plants; it extends also

over the animal kingdom. There it has produced its greatest marvels; for it has not only changed the form of beings, but has modified their instincts to suit his wishes and his necessities.

Dogs, for instance, became at his bidding bull-dogs for the farm, hounds for the chase, King Charleses for the ladies' pets, shepherd-dogs, pointers, etc.

In fecundity too animals have been compelled to obey the will of man. The pigeon increased its laying tendencies from one or two broods yearly to ten or twelve. The hen, which in a state of nature would lay the six hundred eggs in her ovaries in ten or twelve years, has been forced by man to lay nearly all of them in four years.

What man has obtained from dogs in intelligence, and from pigeons and chickens in fecundity, he can obtain from the honey-bee. By judicious breeding and selection he can obtain a stronger, gentler, and more industrious variety.

By a rational system of feeding he can force the queens to lay in two or three years the hundreds of thousands of eggs that their ovaries contain. We should notice that nature is one in its operations, notwithstanding its infinite diversity. To secure a more regular and rapid breeding from the pigeon and the hen it was sufficient to place them in a suitable climate or atmosphere, and to give them an abundance of suitable food. After a few generations their frequent laying became an established habit and a natural necessity.

All bee-keepers know, or ought to, that during spring, if there should be several cold days in succession, the queen will stop laying, and only begin again after several days of mild weather. It is also a known fact that if the bees are placed in a hive sufficiently protected, and if they receive every cold evening a few spoonfuls of syrup, the queen will continue to lay as well as if the weather was warm and sunny. If this attention was continued for several generations, it is possible, nay, it is certain, that the continued laying would become a fixed habit.

A careful choice of breeds; good shelter against the changes of the weather; large hives; straight comb; so that the queen need lose no time for want of room; stimulating feeding during cold days. By these simple means we will certainly accomplish the desired results, and our success with bees will prove even more the power of man over the animals that are subject to his dominion.

WILL IT PAY TO CULTIVATE PLANTS OR TREES EXCLUSIVELY FOR THE HONEY THEY YIELD?

BY "NOVICE," MEDINA, OHIO.

As we have been for the past year quite extensively engaged in collecting facts in regard to the possibility of a "honey-farm," we think perhaps others may feel interested to know what we have gathered.

A host of plants have been recommended for the purpose simply because bees have been observed busily at work on the flowers, and we have no doubt that they found honey, or they would not have been there. Had these observations been made when clover was in bloom, or when they were really filling their hives from some source, we should readily conclude that they were finding honey in paying quantities. But so far as our experience goes there are but a limited number of plants or trees that really enable bees to store up honey from them.

In the fall, when almost all forage fails about here, bees are seen busy on a host of plants; but with their hive on a pair of delicate spring-scales we oftentimes fail to see any increase in weight, but more often directly the contrary.

In the year 1867, we think it was, we moved six colonies of Italians to a buckwheat-field two and a half miles away, and kept them while it was in bloom. They made a beautiful sight, and in the forepart of the day they seemed busier than even during the bass-wood season, as we suppose they *really were;* but they did not store *one pound of honey* more than they consumed. On another occasion we sowed borage for them, not a large plat it is true, but as we then had but few hives we supposed there would be a trace of borage-honey. As we have before remarked, the bees were very busy on it after other sources failed, but "nary trace" of borage-honey could we find.

Fruit-trees have never, so far as our experience goes, furnished but little more than what was used in rearing brood. Last season the shell-bark hickory furnished more than fruit blossoms. Locust-trees gave us in 1870 about one thousand pounds, and there are certainly not more than two hundred and fifty trees in range of their flight. A locust-grove, were it not for the depredations of the borer, we think could not fail to be a good investment,

even if the season is of short duration. They do not all blossom at once, and cultivation, we think, would give a much greater yield of honey. When we remember that it is a very rapid grower, and timber very valuable, we feel almost like wanting ten acres more to plant to locusts. White clover follows so closely that the locust-honey and clover are liable to become mixed. As there are perhaps one thousand acres of white and red clover-fields about us, we shall not think at present of raising more in our locality.

Now then, dear readers, we come to our "hobby"—that "bass-wood orchard." Ever since we have used the extractor we could not have failed to notice the greatly increased amount of honey whenever we remarked the beautiful (to us) odor of the bass-wood blossoms. And during those few brief days, sometimes amounting to three weeks, have we secured fully three fourths of our honey, and they have been to us by far the pleasantest days of the year, even if we have been compelled to toil in the hot sun from daylight until dark; for we do rest under the shade of the grape-vines occasionally, and a dipper of cold water with a judicious admixture of bass-wood honey is all that we could ask for to quench thirst, and the best definition that we can give of "nectar." During these three weeks who could n't raise queens? If we just drop the removed cells on the ground, they are almost sure to hatch out "yellow beauties."

Now all these tons of honey, all these happy days, with the refreshing twilight that follows, while the densely populated hive gives out a loud hum of contentment and prosperity, are the fruits of, dear reader, *how many* bass-wood trees? Count all you can find within a radius of one and a half miles; all the old straggling and decayed trunks; all the long spindling growths that struggle to get a peep through the other trees at the blue above, and how many do we have? These trees, be it remembered too, that yield most blossoms are where the other forest-trees are cut away, and where they can assume their natural round bushy head.

Well, we have studied the subject so far as to thoroughly canvass the forest for two miles around, and find that our ten and a half acres will contain more trees than are growing naturally in that range, and besides growing better ones; we are going to have them all "handy" for our little friends.

Our bees now get the greater part of their bass-wood honey from forests located from one to two miles away (just in the

direction of our "ranche," by the way), and are compelled to come home all the way *up-hill loaded*. If they did three turns that way, what can they do with proper facilities?

Our trees are to be planted twelve feet apart, in the form of honey-comb cells, viz., each one the center of six equally distant. Don't say that is too close till we tell all of it. Our forest researches have shown us that they blossom when quite small, and we want the ground all occupied with bass-wood trees, and when they are crowded we shall remove the alternate ones.

We have purchased from a piece of forest that stock has been excluded from for six or seven years about four thousand trees, and are making preparation to plant them out as soon as the ground can be plowed; have purchased a quantity of bone-dust to put a small quantity in with each tree, and are going to cultivate them *most thoroughly*. After bass-wood fails we generally have little or no employment for bees, and then is the time they are voted a nuisance.

Now if we had some plant or tree that would keep them even moderately busy, say something that would keep ten stocks to the acre, storing each one pound per day, we could well afford the investment. Has any one any positive proof that this has been done? We believe buckwheat does in some localities, at least buckwheat has the credit of it, but the honey is not called of fine quality. We have good authority for mignonette as a honey-plant, and think we shall test one acre this season.

If we are never going to have any artificial comb-crust, can General Adair or some one else tell us how to keep them making *natural* worker-comb during the warm, idle fall weather? It is many times a hard matter to tell just where bees get their honey. For instance, when bees are in new countries and a solitary field of clover is sown, we should be pretty sure if they were busy then and storing honey that it was all from that source, and yet it might be a great mistake. We think such a season as last fall was here some very accurate experiments might be made.

One hundred acres of land planted to honey-bearing trees under full cultivation (remember what the limited number of locusts and bass-woods do here), with such plants as had been *proved* to be really productive of honey, as we have proved the trees mentioned, we can readily imagine might give some great results. If one hundred colonies could be kept at the moderate rate of ten

pounds each colony per day for four months, or even one hundred days, what one hundred-acre farm would pay better?

If any one accuses us of building air-castles, please see if either of the three suppositions are so very much beyond what each one has been made to do in the last few years with our very imperfect knowledge and more imperfect practice. Quite large apiaries have given over an average of ten pounds to the hive per day for a short time, and in each of the months of June, July, August, and September large results have been occasionally realized. Who shall combine the whole or a part of the whole? And when shall the honey-farm first bud and blossom?

Whoever it may be, or wherever located, like all past successes and achievements in bee-culture, none will herald its accomplishment with more genuine pleasure than your old friend,

"NOVICE."

WORK FOR OUR CONVENTIONS.

BY DR. EHRICK PARMLY, NEW YORK CITY.

I am sure many felt as I did on seeing the first number of our American Bee Journal that their favorite pursuit, now establishing a periodical literature of its own, was more dignified and important than many thought it to be, and we all straightway held our heads higher when questioned as to what interest we could find in so trifling a pursuit. We replied, "You are possibly not aware that monthly journals are published in several countries exclusively devoted to bee-culture, and have a wide circulation." "Is it possible!" they exclaim. "What can you find to write about?" "So much, sir, that these periodicals now have a better subscription-list and far better prospects than in the first years of their existence."

New questions are constantly arising and new difficulties present themselves to be surmounted, and these are laid before the readers for solution. A better class of men are joining our ranks; a more liberal and brotherly spirit is obtaining among them, and also an increased self-respect that is very gratifying to the faithful, earnest men long in the field, and who can look back to dark days,

when they stood almost alone and without that encouragement and sympathy that comes from companionship of liberal minds in work and investigation. No social meetings, no societies, no bee-keeper's conventions in those days. Our only representative in public the trickster, or bee-charm man, at our fairs.

It seems to me we have now arrived at a period in our history when we should avail ourselves of the benefit of organized effort to accomplish that which it is not advisable to undertake single-handed, owing to the great expense and risk, and doubtful advantage, pecuniarily considered—namely, the study and importation of varieties not yet tested in this country.

I am in a measure led to these remarks by the want of success we have met in importing the Egyptian bee, and the difficulty we have had in even obtaining specimens or any information of value from distant countries of their native bees, which arises from the ignorance on this subject of the parties addressed rather than any lack of willingness to oblige us, as evinced by their correspondence.

I would propose that the bee-keepers of the country unite in subscribing to defray the expenses of a practical apiarian, possessing marked fertility of resource, to visit the old world and make himself acquainted with bees that have not been intimately studied. The three kinds of East India bees described in the American Bee Journal for December, 1870, need further study. Apis Dorsata, I think, deserves attention. It gives promise from its size of being able to work on plants not visited by our smaller bees.

From the success that some have had in controlling fertilization we have now an additional inducement for testing varieties. The sum requisite for the above undertaking ought to be easily raised among the bee-keepers of the country. I think it would be money thrown away to attempt importation from such distant points without the personal supervision of a practical man from the start to the end of the journey.

What pleasure this increase of knowledge would give to thousands! The benefit can not be estimated. With promising fields open to us let us avail ourselves of them by subscribing liberally at an early day, and selecting our man for this. Such a work could be done by the "Father of Bee-culture in America" in a way to reflect great honor upon us if he could be persuaded to undertake it.

We will be respected and respect ourselves in proportion to the magnitude of our efforts in our calling. So long as we confine ourselves to small questions and issues we can not expect the esteem of earnest men in other callings. We will be judged by our acts. We must stand on a broad platform, and not feel satisfied until we know intimately the natural history and domesticity of all the varieties of the honey-bee in both hemispheres. This knowledge is within our reach. Why not gain it? We ought to keep at this work until we have full knowledge of the bee throughout the world. If we can not do this alone, then let us join hands with the apiarians of Germany, England, France, and Switzerland, and conquer success by a well-organized effort.

THE ESSENTIALS OF BEE-KEEPING.

BY DR. JEWELL DAVIS, CHARLESTON, ILL.

In the Bee-keeper's Directory, page 201, J. S. Harbison says: "There are three requisites necessary to obtain surplus honey; the first of which is a hive, the main apartment full of comb, with the interspaces full of bees (*no danger of being too many*); the second, abundant pasturage; and the third, favorable weather. With these three requisites, boxes for the reception of surplus honey may be added with the assurance that they will be filled in due time."

Again, on page 197 of the same work, he says: "The aim of every bee-keeper (who understands his business) will always be to keep his stock in such a shape that he can have his hives full, and ready to store surplus honey at the commencement of a harvest of flowers that are known to bloom at a certain time. The essentials then are to keep the stocks strong by furnishing pasturage, or feeding at a time when nature does not afford a supply."

From the above quotations I find it essential also to successful bee-keeping that we have a *man of understanding*, who is fully acquainted with the nature and habits of bees, and how to prepare the pasturage that will yield its thousands of "luscious sweets," and how to make the house they should live in to most favor a

large storing of surplus honey—the great desideratum for which bees are kept.

We must therefore turn our attention to the man who contemplates keeping bees. He must be a man who understands the essentials of that business in which he is about to engage or he will fail to make it a success; he must then be intelligent, at least so far as bee culture is concerned; he must know the nature of the bee, its peculiar habits, and how to supply all their natural and necessary wants; he must learn that "the existence of all animated nature depends on the earth's yielding her fruits in their appointed seasons. The increase and decrease of every race and class of the animal and insect kingdom are governed by the same. Hence we find the bee to increase most and flourish best where the earth yields the greatest profusion of flowers through the greatest number of months in the year." (See Bee-keeper's Directory, page 169.)

The man then who is alive to profitable bee culture will seek for the location of his apiary where there is an abundance of honey-yielding flowers as the spontaneous production of the soil, or he must cultivate them for that purpose, and he must arrange their cultivation so that they will be almost in continuous bloom from spring until fall for the benefit of the acquisitive nature of his bees, thus securing the largest amount of honey that can be gathered in either favorable or unfavorable seasons. He must provide a hive that will meet their and his wants in storing honey and the increase of his stocks; to maintain the species and increase the keeper's wealth. All hives are not made with these chief objects alone in view, but occasionally, to gain an "almighty dollar," either by sale of a "patent-right" or a "cheap hive." The best hive can not be made *so cheaply* when you take into consideration their honey capacity, and the ease of artificial swarming which is required at the hands of the expert and successful bee-keeper, and in this fast age of improvement in rearing queens in the queen-nursery, and having them fertilized in the *bridal-chamber* connected with their hive and nursery, and warmed by the bees of the stock where the nursery is. All these are considerations essential to this improved bee-keeping age. Of course it is not my purpose to call attention to any person's particular make of hive as the best; there are many good ones and many poor ones; that is, poorly adapted to the ends I have indicated. The understanding bee-keeper will remedy all these

defects as fast as he discovers them by something better, whether covered by a patent or otherwise. Movable-comb hives are among the indispensable essentials to improved bee culture; and I may here suggest another feature of some value to the extensive bee-keeper whose *time is precious*, viz., the arrangement of his hives so he can get at his bees with the least loss of time; to make swarms, remove and introduce queens, use the queen-nursery, find what condition the stock is in, whether in possession of a prolific or superannuated queen, etc.

I may say further that all hives are not adapted to convenience in these respects, and most all movable-comb hives subject us to the necessity of *removing* the cap, honey-board, and honey-boxes before we can have access to the combs and brood-chamber, or perform any required operation there. I will therefore suggest again that a hive which will not require *these removals every time* we wish to examine the brood-chamber, to find queens, make swarms, or learn their condition, is the one that suits me better than all others, provided it is made with equal honey capacity compared with any others.

Above I have indicated that we must turn our attention to the cultivation of honey-yielding flowers, in all localities where they do not grow spontaneously, in sufficient quantities for the large amount of honey we wish to gain; and I may here repeat that in this cultivation we must arrange it so as to keep the flowers almost in continual bloom the entire summer, so that our bees may be constantly acquiring stores; they are always ready for this work, and a rich harvest if they are numerous and strong. Some plants yield more honey than others, comparatively, in favorable seasons. The same is true of some plants in unfavorable seasons, perhaps chiefly because deeper rooted, endures the drought better, and secretes or excretes more honey.

Wisdom in bee culture then will indicate that we investigate the *peculiar worth* of all the flora of America, as controlled in the secretion of honey, under all the changing vicissitudes of atmospheric influence. And in connection with their worth for other agricultural purposes, the clovers, especially the white and alsike, buckwheat, and purple polanisia, perhaps, are the chief among the plants to be cultivated. Nearly all the fruit-trees are valuable, also all the small fruits should have a conspicuous place near our apiaries; many of these are great favorites with the bees. The polanisia is particularly visited by them in dry seasons, and per-

haps nothing that we can cultivate can compare with it in such seasons, as it keeps the bees employed from morning to night, and from four to six weeks at a time, when most needed to keep the bees breeding and our stocks strong, thus preventing our stocks from dwindling down to the point where the moth-worms take possession and destroy them, or the winter coming finds them with less than a gallon of bees, or an insufficient quantity to generate the required amount of animal heat to keep them from perishing, as in the winters of 1868 and 1870.* That the hot and dry season of 1870, in many places, has been unfavorable for bee-keeping can not be denied. The dry weather cutting short the supply of honey in the flowers, the bees fail to feed the queen, and she is not stimulated to breeding; the stock diminishes in numbers if such a season is long protracted. The queen ceases to breed either wholly or partially during every dearth of honey, and if long continued we are sure to lose our bees, unless we feed them to keep them populous, and plenty of stores.

To sum up then, we must have an intelligent apiarist, a good location, plenty of pasturage, a good hive with all its indispensable fixtures, and improvements for rearing queens, feeding and stimulating them to breeding, to save our bees in unpropitious seasons, and their loss by the chill of winter and old age.

WHY NEWLY-HIVED SWARMS DESERT.

BY ELISHA GALLUP, ORCHARD, IOWA.

The subject now before us is, why do bees desert their hives after being hived? etc. Some say one thing and some another. Some recommend washing the hive with salt and water, some with sweetened water, some with whisky; some recommend rubbing the inside of the hive with peach-leaves (not knowing that we northern bee-keepers have no peach-leaves). I once knew an old maiden aunt to rub the inside of the hive with the leaves from a sweet apple-tree, and she claimed that it was a certain

* This is true only when the honey-crops failed.

preventive. The bees always staid, etc. One claims newly-dressed pine is offensive to bees; another that freshly-painted hives will make them desert. One claimed that he set a swarm near a pile of leached ashes, and the smell of the ashes caused them to desert; another near the pig-sty, and the scent from that caused them to desert. And I might go on enumerating absurdities like the above, and we should never arrive at any correct conclusion. If we examine closely into the above we shall see that every one of the above advocates believes that there is something mysterious, or that there is a certain remnant of old and ought-to-be-exploded superstition about bee-keeping, etc., etc. Now I have hived bees into pine, hemlock, spruce, butternut, walnut, oak, white-wood, bass-wood, and cherry, and I never allow anything to be rubbed in the hive. I have hived bees in freshly-painted hives, and I have painted them on the same evening after hiving; and I have painted with Paris green, Venetian red, yellow ocher, white lead, etc., and if the weather is fine and the bees are gathering foliage abundantly, I never put anything but bees in the hive; that is, I never take the trouble to put in a card of brood and honey to make the bees stay; but famine and excessive heat will cause bees to desert.

Mrs. Tupper says, in the Bee-keeper's Journal, "that bees *never* will desert if we put in a card of unsealed brood with the newly-hived swarm. But this statement ought to be qualified a trifle. For if the weather becomes unpropitious for gathering forage, and remains so for several days, they will desert on account of starvation, unless they are fed, and they should be fed abundantly at such times. Again, excessive heat will compel them to desert both brood and honey. The past season I experimented somewhat in this line. I took swarms or stocks that had all the common entrances open (strong stocks), removed all the comb but one card containing unsealed brood, and brushed the bees back into the hive early in the morning, removed the shade from the hive, and about twelve or one o'clock out would come the bees. The thermometer was at 90 or 95 in the shade. Now raise the hive an inch on the front side, shade it from the sun and re-hive them and they were all right. I tried this experiment on six stocks, three of them I raised the hives and kept them shaded and they did not swarm out. The other three I left without shading and did not raise the hive, and all three swarmed out. The fact is excessive heat will cause a swarm to desert all their

comb and brood. Then of how much importance is it when hiving a new swarm to give them abundance of air, and keep them shaded from the broiling hot sun. In excessive hot weather you can safely hive a swarm in a hive without any bottom-board on the hive. I have done so often, and this is one great reason why I do not like a permanent bottom-board to my hives. On the other hand, if the nights are very cool, the hive should be closed at night, or in very cool weather; for we know that cold will cause bees to desert and leave all their stores in the fall.

I never lost but two swarms of bees by flight in all my experience. I had one leave on account of the hive being too smooth. I followed them up, cut down the tree, scratched up the hive on the inside rough, rehived them, and they were all right. I lost a swarm last season under the following circumstances: it was an extra large swarm; I hived it three times, and it came out the fourth time. I then found the queen, clipped a wing, rehived them, and gave them three cards of brood, and just about sunset out they came and put for the woods, and there was no stopping them. I found the queen with the clipped wing in front of the hive. And here was a poser for Gallup; for I knew the hive they came from was a first swarm, consequently had an old queen. But on examining the hive they came from I found the old queen had been superseded, and two young queens had hatched out both at the same time, and had both issued with the swarm, and the swarm being an extra strong one, they were determined to keep both queens; hence their swarming out so many times, and finally learning, at least, that was the only rational manner of accounting for their bad behavior. I lost another swarm last August by sheer carelessness. I had two large swarms come out quite early in the morning. I hived them, and set them in the shade as I supposed, gave them plenty of ventilation, and they went to work. But about two o'clock in the afternoon out came one swarm and put for the woods. They went about half a mile into a large oak, and on examining for the cause I found that there was an opening in the grove that let the hot sun pour right down on to the hive, and this was more than they could bear. So they were compelled to go.

Motto: Use common-sense and not peach-leaves to rub a hive with, and I guess you are all right.

WHY DO BEES RAISE QUEENS.

BY D. L. ADAIR, HAWESVILLE, KY.

It is well known that if you remove the queen from a colony of bees that they very soon commence to rear another. It is also well known that when a hive becomes very populous, and honey is being gathered plentifully, that the same thing occurs. It is also a fact that if you take a quantity of bees, more or less, without a queen, from a colony, and give them eggs or young *larvæ*, they will also proceed to raise queens. When a queen becomes old and fails to lay eggs sufficient to keep up the population of the hive they will do the same thing, and raise a queen to take her place.

Why do the bees so act? Can we suppose that they are endowed with the knowledge of their condition? If we do, can we further suppose that they know what to do to remedy the evil that has befallen them? If so, how do they know? Who or what has taught them? We must remember that the life-time of a worker-bee extends over but a few weeks or months, while a queen lives several years, and consequently that in most instances when queen-cells are built and queens reared it is done by bees that never saw a queen-cell constructed, and are without experience in producing perfect queens. It is as common as it is absurd with novices and enthusiasts in bee-culture to attribute great wisdom to bees. We have heard reputable bee-keepers speak of educating them; when the truth is that they are alone impelled by an undeviating instinct, with no "free-will" or control over their actions any more than the plant or tree that is devoid of animal life. Their strongest instinct is the perpetuating their species, and when extinction is threatened they each, the bee and the tree, put forth efforts for reproduction.

Every experienced horticulturist knows that a tree or plant whose life is threatened from injury or disease, although not of an age to bear fruit, is immediately forced into bloom and the production of seeds for continuing the species. This tendency is taken advantage of to produce fruitfulness in the over-luxuriant and consequently barren fruit-tree by mutilating its roots, or cutting a ring of the bark out so as to interfere with the circulation of the sap. So do experienced apiculturists know that, when from any cause reproduction is retarded or stopped, the

queen-cells are formed as certainly as the fruit-bud, and in the multiplication of queens they take advantage of it in producing them. This instinct is independent of will or education altogether, as is proven by the fact that no choice or discretion is shown; for it is a fact, as stated by Lord Brougham in his work on "Instinct," "that as in plants where the motions are without animal life, those motions are more perfect and undisturbed, so if there be any animal wholly without reason, the operations of instinct are the more regular and perfect; and in any animal whatever they are so in proportion as reason is dormant or inactive."

Bees act now as they did in the beginning. The fossil-bee and its work, as it existed sixty centuries ago, does not differ from the bee of to-day. The comb was the same; their habits have not changed; they have learned nothing. While man may have been a monkey then, according to Darwin, a bee was not a gnat. While the regularity and perfection of the bee's work are proof to the novice that they are endowed with reason, they prove to the naturalist that they are devoid of will or discretion.

Taking this view of the matter, we must be permitted to deny that they comprehend their condition when queenless, or the necessity for rearing queens preparatory to swarming, or to supersede a queen that is superannuated, and we will have to account for the impulse on other grounds.

In order to do so it will be necessary to look into the hive and notice some of the peculiar habits of the bees. It is known to be true that during a period of the early life of the worker-bees they do not go out as gatherers of honey or pollen, but are confined to the labors inside of the hive. It is they who feed the *larvæ* in the cells. Their organs are not then fitted for outside labor, but they are fitted, as intended, for mixing the honey and bee-bread and forming the pap or food to rear the grubs. It is more than probable that when they are old enough or sufficiently developed to go out into the fields for other labor they lose the power of doing so. Their stomachs are no longer capable of the partial digestion of the larval food; while young they are, and it is likely that they can not resist doing so. The appetite to take into the stomach what is not necessary to their own sustenance is irresistible. It is retained there until it is fit food for the embryo in the cell, and then is disgorged. As long as there are grubs to be fed they find a place to deposit it.

Now remove the queen from the colony, and consequently stop the depositing of eggs; the secretion or preparation of the larval food goes on as before, but the bees find no place to deposit it, after supplying the grubs left and the hatching-eggs. It accumulates in their stomachs until they are compelled to disgorge it. It is placed in a cell, as before, that either has an egg or young larva. From being retained longer in the stomach it is more thoroughly digested, and perhaps is changed in character. It is deposited in such quantities that the larva swims in it, the cell has to be enlarged to contain it, and the result is a queen-cell.

When honey is being gathered abundantly the queen is stimulated; so that, in a hive of ordinary dimensions, she fills all of the cells with eggs and finds no place to deposit any more. Breeding has been going on rapidly and the number of young bees is great. When the queen checks up in laying they find themselves in the same condition as if they were really queenless. They generate more larval food than they have grubs to feed it to in the usual proportions, and the result is the same—queen-cells are built.

We find in this case some phenomena to exist that do not in either of the other conditions that induces the construction of queen-cells. The queen, not finding cells in which to deposit the eggs that continue to develop in her ovaries, drops them about the hive. The nursing bees gather them up and stick them on the edge of the comb and form cells around them. I have seen in several instances queen-cells built over eggs on the bottom-board of the hive; and in one instance a queen-cell was matured in a honey-box in which there was no other brood. This condition of things has a singular effect on the whole colony. It becomes disorganized. The queen becomes restless and belligerent; her first impulse is to destroy the queens in the cells. The nursing bees cluster so closely over them that she is prevented. The hive becomes in some way disagreeable to the mass of the workers. The unity of the colony is broken up and the result is swarming. Why the swarming impulse should seize on them I do not now propose to discuss. The same wise Providence that mounts the seeds of the dandelion and thistle in balloons, and gives wings to those of the maple and ash, and at the appointed time impels them to leave the mother plants, has endowed the bees with the instinct to multiply and swarm. The natural laws by which they are governed may be more difficult to understand, but are as certain in their operations.

Swarming has generally been accounted for on the ground that the hives become overstocked and crowded with bees. This does not account for it, for bees will swarm sometimes if hived in a hogshead, with plenty of room for all. On the theory here advocated the swarming under such circumstances becomes apparent. When a queen is so old that she fails to lay sufficient eggs, the nursing bees find themselves in the same condition as in the case of queenlessness; or when the queen, having filled all vacant cells, no longer supplies the brood to consume the larval food, and the building of queen-cells for the same reason follows—more than one queen being produced to take the old queen's place—if the hive is populous they will swarm sometimes. From an ignorance of this fact all attempts at making a non-swarming hive by giving extra room have resulted in failure.

After what has been said it is unnecessary to explain why a quantity of bees of the proper age when taken from a hive and given eggs or brood will build queen-cells. It is equally unnecessary to explain why old bees fail to do so.

As further proof of the truth of the theory, I may remind the bee-keepers that when a queen is caught and caged, or, in Italianizing, another queen is caged and placed in the hive, the bees will commence queen-cells. It may be laid down as a rule that *anything happening that checks materially or stops entirely the supply of eggs, when there are bees in the hive of the proper age for nursing, has the effect to induce queen-rearing.*

I am not aware of any conditions under which queen-cells are built that this theory does not account for. Some of our earlier authors in their inability to account for every motion of the bees as the result of instinct, in their enthusiastic admiration have tried hard to prove them endowed with reason. It seems to me that no one who has experience enough to see that under the same circumstances their actions are always the same can long indulge in such a fiction. To attribute to them passions and emotions like ours is simply absurd. In all that bees do they are guided alone by the immutable laws of nature; that "they have no power of resisting, and for that reason all they do is perfect. Under the same conditions the same impulse is always excited. Not so with reasoning beings. No two communities have the same habits; no two governments the same laws; no two mechanics work alike, except as they learn from each other.

However much such authors may have done for the advancement of apiculture, their teachings in this respect are almost as great a clog to it as are the old superstitions of those who leave it all to luck.

I lay it down therefore that under certain conditions bees will always rear queens. They are:

1. There must be in the hive a certain proportion of young bees.
2. There must be less larvæ to feed than they can supply with food.
3. There must be uncapped female brood or eggs.
4. Honey and pollen must be plentiful.

Any of those conditions wanting, no queen can be produced.

CHEAP HIVES.

BY D. L. ADAIR.

It is an error to suppose that the cheapest hives are the most desirable. Many of the hives lately introduced present cheapness as one of their principal recommendations. In order to do so they have to be made so small that they are worthless. A hive with only a cubic foot of room for brood and stores, and box-room for fifteen or twenty pounds of surplus honey, is no hive at all; yet such is the capacity of many of those lately introduced that have a large sale based alone on cheapness. At the present price of labor, unless machinery is used, even such hives can not be made and finished off as they should be for less than two dollars and fifty cents to three dollars. All that such hives are good for is to produce swarms. For the production of honey the old box and cap is preferable. Four thousand cubic inches is as little as any hive should contain to produce the best results; and while such a hive will not cost double as much as the former, it will produce eight or ten times the clear profits, besides avoiding the trouble that the perpetual swarmer involves.

It is folly to suppose that one hundred pounds of honey can be stored where there is only room for twenty, or that twenty

thousand bees in a disorganized condition, that are kept most of the time in the feverish excitement of swarming, with several thousand drones to be fed, can produce as much as one hundred thousand perfectly organized with nothing to interfere with their operations. Ten hives of the proper size and construction, costing fifty or sixty dollars, will produce more honey than one hundred of the so-called cheap hives, that will cost two hundred and fifty to three hundred dollars; while the bee-keeper can manage one hundred of the former with as little trouble as fifty of the latter.

EDUCATING BEES.

BY D. L. ADAIR.

In nothing the bees do can we perceive anything that indicates the workings of reason, or even the sagacity of higher animals that are capable of imitating, and through that instinct can be taught to do things that they do not comprehend.

We see a certain thing done which we know they have never seen done before, and without any instruction, which we know man could not do without much instruction and a long practice. We see them repeat the same work, but it is always under the same circumstances, and they always do it in the same manner; everything is made exactly alike and of the same material; whereas no two men work alike, nor any one man twice alike. They do a thing that is to produce a certain effect, and at a time when it is absolutely necessary that they should do it, without any experience, and without even knowing what they are doing, why they are doing it, or what will be the result.

In proof of this, take a sheet of brood that is just ready to emerge from the cells. Brush every bee off, place it in a hive where it will not chill, and let the bees come out. A sheet ten inches square will produce five thousand. Not one of these bees ever saw an egg, nor a queen, nor a grub, nor a queen-cell. Now give them a piece of comb containing eggs. As the grubs hatch out those bees that never saw a grub before take the honey and pollen, prepare it fit for the tender larvæ. They feed them just the quantity they need, and just at the time they need it, neither more nor less, nor sooner nor later. From the most of them they

rear workers like themselves; from others perhaps drones are produced.

This is truly wonderful; but more wonderful still these bees that have never seen their mother, and have had no means of being informed of the necessity of a queen to continue the race, set to work and construct cells different from any before in the hive; different from any they have ever seen before. The *larvæ* over and around which they build them are furnished with food in greater quantities and, it may be, different in quality. It is at least more thoroughly digested or prepared, as we may infer from the fact that the larvæ fed on it mature more rapidly.

All of this work is evidently done blindly, and positively without knowledge or instruction; intending nothing, meaning nothing, and not designing to do what it accomplishes. The result is the production of a description of bees unknown to them before, so different from all in the hive that they have no instincts common with them.

In like manner we might follow the bees in all they do without finding any proof that they have the least glimmer of reason, or that they are capable of departing in the smallest degree from the blind impulses of their unvarying instinct.

THE SIZE OF BEES AND THEIR CELLS.

BY D. L. ADAIR, HAWESVILLE, KY.

The cell of the honey-comb has been a wonder on account of its shape, but I have seen no reason given why it is always about a certain size. This fact, I conceive, is no less a subject of wonder than that, and is of an easy solution, determined as it is by plain physical laws.

A friend who lives some ten miles distant, having heard that I had the Italian bees, rode over one day to see them. His curiosity had been greatly excited by what he had heard about them. He had hardly dismounted before he let me know his errand.

"Well," said he, "I understand that you have a new breed of bees, as big as bumble-bees, that make comb with cells in it as big as a thimble, that have no stings, and make honey all the

year round. I came over to-day to get some, as I understand that one or two is all you need to get a start."

I informed him that he was slightly mistaken, that I had no such bees, and that no such bees existed; that I had the Italian bees that were a little larger than *some* common bees, but that I had the common bees as large as the Italian; that they had stings, but had the reputation of using them with more discretion than the common bees; that as to their making honey "all the year round," they did not *make* honey at all, but gathered it from flowers, as all other bees did, and whenever flowers failed to secrete honey they must stop storing it.

"My dear sir," he replied, "you are not posted; for Mr. A—— told me that he saw them at Newburg."

Now I had acquired some reputation for bee knowledge, however undeservedly, and to save it with my friend I had to maintain my position in this wise:

"All the habits and instincts of the bee would have to be changed if it grew to such a size. The comb would have to be built differently. Instead of hanging it in sheets in the hive vertically, with horizontal cells on either side, it would have to be in sheets horizontally, with cells only on the upper side; for if the cells were as large as a lady's thimble, or even a very little larger than they now are, the honey would run out of them as fast as it was put in. The cells in which the worker-bees are reared are about one fifth of an inch in diameter; the cells which are built for storing honey alone are a very little larger, fourteen measuring three inches; and that seems to be about the maximum size of cells that can be placed in a horizontal position and retain the honey when placed in them. The drone-cells are about one fourth of an inch in diameter, and when used for storing honey in have to be turned up from a horizontal position, sometimes as much as 30°, in order to hold it."

"All that seems reasonable," he admitted; "but why should it be so? Could not this big bee make the honey stay in the big cell as well as the little bee in the little cell? Each would be in proportion."

"Nature does not permit miracles now-a-days," I answered. "Every substance exists as such by reason of certain essential properties or qualities. Destroy any one of those belonging to any one substance and you destroy the substance itself. Among the properties common to all substances is one called attraction.

which is an inclination in bodies and particles of substances to tend toward each other. This property pervades all material things. Destroy it and you resolve creation into chaos again. It not only causes atoms to adhere together and form different substances or bodies, but holds them all together in a great body we call the earth, and holds all the heavenly bodies in their spheres as they revolve through space.

"Attraction of cohesion is the name given to that force which holds together particles in bodies or masses; and it is through an instructive knowledge of this much philosophy that the bee is enabled to stow the honey in the vessel it makes for it."

"I can not see it," he said.

"How long would it take you to fill a barrel with molasses or water if you should lay it on its side and remove one head?" I asked him.

"That would certainly be a fool's job," he answered. "I would greatly prefer the performance of eating soup with a fork."

"Yet your big bee that should build its cell as large as a thimble would have the same sort of a fool's job before it when it undertook to fill it with honey."

"But why won't it run out of the small cell as well as the large one, or as the molasses out of the barrel?"

"That's what I'm coming to. Dip your finger into honey and hold it up with the end down, and you will soon see that the honey will run down as impelled by gravitation, and collect in a globular drop at the lowest point. That drop or globule will increase until it attains a certain size, when it will fall off. If you measure the diameter of the drop of honey, you will find it to be about the same as the worker-cell."

"I can not see," interposed my friend, "what connection there is between the honey dropping from the end of your finger and the size of bees, or even their cells."

"I will try to explain if you will be patient. The size of the drop indicates the cohesive force with which the particles of honey are held together; when another kind of attraction, called gravitation, is brought to bear on it."

"The same that Sir Isaac Newton, I think it was," he put in, "got up to gather apples with."

"The force had always existed, but Newton was the first to discover and define its operations. If the drop only attained a certain size it would remain suspended; the force of cohesion

would be greater than gravitation; but other particles added give the latter the advantage, and consequently the drop falls, as did Newton's apple. The honey is held in the cells by this very attraction of cohesion, and consequently the cells have to conform in size to the drop of honey, or the other attraction, gravitation, would cause the honey to run out."

"Ah! I see now what you are driving at," exclaimed he, "and consequently the bee can not be any larger than the cells, as it has to go into them to put its honey in and to get it out. If it were otherwise the bees would be in as bad a fix as the fox Æsop tells about, who went to dine with the crane, and had minced meat served in a bottle."

"That is one reason, but not the principal one. The queen lays her eggs in the bottom of the cells, where they hatch, are fed by the nursing bees, undergo the different transformations, and emerge full size. Of course they can be no larger then the cells in which they were reared. This is so true that drones which are sometimes reared in worker-cells are no larger than worker-bees, and I have known workers reared in cells built so near the sides of the hive that they could not be made of full depth, that were but little larger than house-flies."

"So," said my friend, "the cell is a sort of Procrustean bed, and those that occupy it must be made to fit it. I think I will go home and quit hunting bumble-bees."

"Stop awhile till I give you another idea in this connection. Does not this also explain the shape and arrangement of the cells? A great deal has been said and written to explain why the bees build their cells with such wonderful uniformity of angle and such remarkable economy of space. Many solutions have been proposed, but none of them is entirely satisfactory. Another law of attraction is 'that when particles of fluids are left free to arrange themselves according to the law of attraction they assume the form of a globe or ball.' For instance, the drop of honey just spoken of, the dew-drops on the leaves of plants, tears running down the cheek, and drops of rain; shot are made by dropping the lead in a molten or liquid state from high towers; as soon as free each separate mass or drop assumes a globular form, and, cooling before it finishes its descent, forms a shot.

"Now the cells being constructed primarily for the purpose of holding honey, it is but natural to suppose that they would conform in shape, as near as possible, as well as in size to the

substance which they are intended to contain; therefore they would be circular; but when we come to set them together we find that they will not fit each other, and that there is a great loss of space. If that space is filled with wax, there is a loss of material; so nature, always economical, adopts the only shape that will answer the purpose for which they were intended; and, constructing all the walls and partitions of an equal thickness, the thing is done without requiring the bees to work out a difficult mathematical problem. There is no other shape except a triangle or a square that could be adopted, and they would neither suit the form of the maturing bees nor be of such a shape as to take advantage of the law of cohesion in retaining the honey. The hexagon varies so slightly from a circle that it is substantially the same.

A GREAT fault with most authors writing of the bee is that they but repeat what others have said without having observed for themselves. In this way some of the most fatal errors have been thoughtlessly taught by repeated repetition.

It has been repeated so often that a circulation of air through the hive is necessary, that nine tenths of the bee-keepers persist in keeping a draught through it, when the truth is that the only openings should be at the entrance.

We are also repeatedly told that bees can not use as food candied or crystallized honey, when the truth is that they can eat even rock-candy if they have the proper degree of moisture in the hive.

A STRONG colony of bees has been known to build one hundred square inches of comb in twenty-four hours; at that rate over sixty sheets of comb a foot square could be constructed in three months. The editor of the Annals of Bee Culture has had a report of a swarm that built nine sheets of comb ten by thirteen inches in ten days.

A LARGE natural swarm of bees carries with it four or five pounds of honey when leaving the old hive.

WILDMAN says: "There seems to be a hidden quality in some men which renders them disagreeable to the bees."

PERFECTION IN BEE CULTURE.

There is no owner of half a dozen colonies of bees that has not had the opportunity to notice that frequently there will be a single colony that will far excel in yield of honey any of the others. They may be all in hives as near alike in size and construction as possible; they may be all managed as near alike as the bee-keeper knows how; yet one will distinguish itself by heaping up unheard-of-before quantities of honey.

Such a result must have a cause, or perhaps a number of co-incident causes. To ascertain these causes is the province of the scientific apiculturist.

The fact that an apiary of one hundred colonies produces an average of one hundred pounds of honey is of little value, and teaches nothing unless we are informed of how it was managed. That one tenth of the hives produced only an average of ten pounds each, and another tenth produced an average of two hundred pounds each, should lead us to try and answer the question: "Why do not all produce the maximum?"

We have instances reported where five hundred and even seven hundred pounds of honey have been secured from a single colony. What it is possible for one colony to do is possible for all; and until the bee-keeper shall be able to so understand and control the operations of his bees that he can bring them all up to the highest standard of productiveness, the science of bee culture will be imperfect.

D. L. ADAIR.

Mr. L. C. WAITE writes to the editor of the *Annals of Bee Culture*, as follows:

"Advise bee-keepers to feed rye-meal when pollen and honey can not be gathered, and to give plenty of water; and if a very dry season to feed honey and water by putting it in a fruit-can, with coarse cloth tied over top and hung up inverted near apiary, and the bees will keep away from decayed fruit. I succeeded in keeping my bees at home last August and September, and saved thousands of them by so doing."

BEES will make more wax when fed on sugar-syrup than when fed on honey, and will winter better on it.

EDITORIAL SCRAPS.

FIVE pounds of sugar fed to a colony of bees in March and April will secure the return of fifty pounds of honey in June. There are more bees lost by starvation in early spring than from all other causes during the winter. As soon as the first food is carried into the hive in spring the queen commences to lay her eggs; an unfavorable change in the weather cutting off the supply of food endangers the life of the whole colony. They should be fed to prevent this, and also to stimulate the queen as much as possible, so that they may be strong when honey becomes plentiful enough to gather a surplus.

THE ovaries of the queen-bee contain the germs of about half a million of eggs, and when they are exhausted the queen dies. A prolific queen will lay them all in two years, while others take five or six years to accomplish it. The latter are unprofitable and should be destroyed. A queen that is stimulated to lay to her utmost capacity during the first month of her laying will be prolific all her life; while one that is so situated or treated that she lays little or none during that time will likely be unprolific as long as she lives, and will live a long time.

AMONG other errors that have been stated and restated until it passes for truth, is the assertion that bees never voluntarily sting when filled with honey, and that bees when alarmed will fill themselves with honey, which renders them peaceable; or that the reason why bees are not so apt to sting when they swarm is because they are all filled with honey; for a hungry swarm that deserts its hive because they have no honey is as well disposed as that which issues from the richest hive.

BEES require to be managed differently in different localities, depending on the honey-producing plants. Over large districts the honey-season is over by the last of July, while in other localities the best honey-season is after the first of September. Where honey abounds the whole season through is the bee-keeper's paradise.

IT is a bad plan for a novice to buy a large stock of bees to commence with. Get a few, and increase them as your knowledge and skill increases.

WHENEVER a queen becomes unproductive she should be destroyed, and one that is young and prolific put in her place, whether that unproductiveness arises from old age or other causes. It is poor economy to keep a queen that will only keep up the population of the hive to a living point when it is so easy to supply a better one that will yield a surplus of honey.

WHEN bees are gathering honey rapidly they frequently crowd the brood-nest of the queen so as to restrict her laying. They should be examined often, and any honey so improperly placed should be removed by the melipult, and empty frames placed in the center of the hive to be filled with new comb, which is always preferred for brooding by the queen.

SOME authorities state that the queen and drones never feed themselves. This is an error, as I have frequently witnessed. The queen does not feed herself when she is laying eggs rapidly, as her digestive organs are insufficient to digest the material for the great number of eggs she produces. The worker-bees feed her on prepared food, which they digest for her.

Mr. A. F. MOOR, of Michigan, now editor of the North American Bee Journal, stated at the meeting of the North American Bee-keepers' Society at Cleveland that he knew an instance in which bees swarmed in the night.

Mr. J. W. HOSMER, of Janesville, Minn., extracted twelve thousand pounds of honey (six tons) in two weeks from one hundred colonies of bees. He had one colony that gathered fifty-three pounds of linden-honey in one day.

ALL that bees do is susceptible of explanation without going to the extremes either of considering the insect as a mere machine, or endowing it with intellectual faculties like the higher order of creatures.

TO KNOW what to do, how to do it, and to do it at the right time, is the great secret of success in bee-keeping as well as in every other calling. Ignorance, awkwardness, and untimely work are sure not to succeed.

GENTLENESS and a little smoke is the best bee-charm.

THE golden rule in bee-keeping: *Keep your colonies strong.*

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